INTERAVIA

REVIEW OF WORLD AVIATION

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IN THIS ISSUE

AIR CARGO

VOLUME VI 12 1951

GIANT DOUGLAS FREIGHT PLANES

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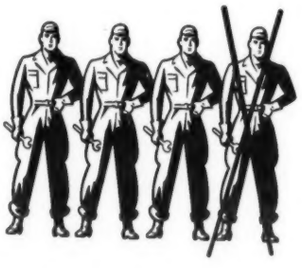
AT MORE THAN 300 MPH the huge Douglas DC-6A *Liftmaster* speeds freight between distant cities. This is the world's first high-altitude, high-speed, all-cargo airplane—*the only one now in service*! Two-end loading doors and single-compartment interior make freight handling swift and easy.

ONE-THIRD LESS COSTLY to operate than the world-famous Douglas C-54 (DC-4), the *Liftmaster* brings a new concept of economical airlift. Able to land and take off from medium-size airfields, it transports 26,400 lbs. of freight at more than 300 mph on missions of global scope.



ONE-FOURTH LESS MANPOWER is required by the *Liftmaster*, compared with the C-54. Thus, in every respect, this airplane provides an answer to the urgent need of the airlines for swift, long-range, *economical* freight transport.

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Review of World Aviation

Volume VI — No 12 — 1951

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Air cargo waiting to be loaded aboard Curtiss C-46 "Commando" freighters of the Flying Tiger Line at Burbank, Cal.

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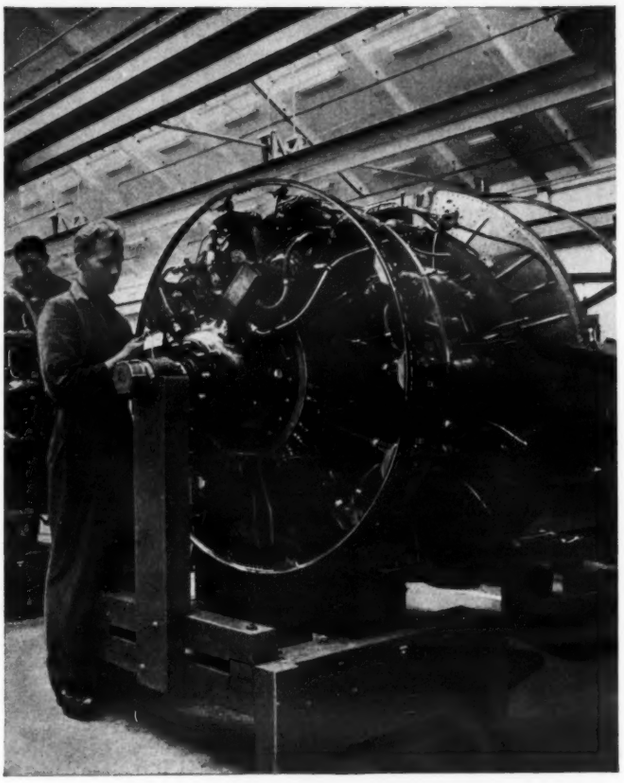

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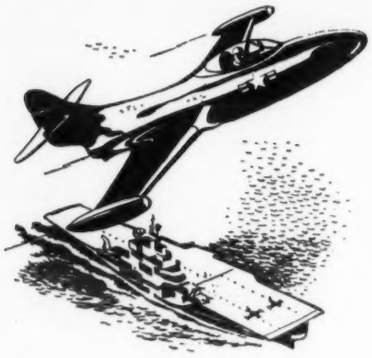
UNITED AIRGRAM

UNITED AIRCRAFT EXPORT CORPORATION

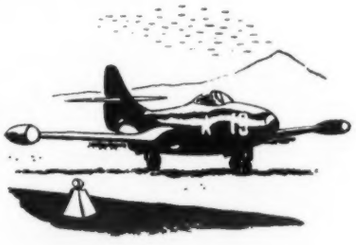
PRATT & WHITNEY J-42 AUTHORIZED 1,000 HOURS BETWEEN OVERHAULS --The Pratt & Whitney J-42 Turbo-Wasp has recently become the first U.S. jet aircraft engine to reach an officially authorized service life of 1,000 hours between major overhauls.



The 1,000 hour overhaul interval was authorized by the U.S. Navy's Bureau of Aeronautics as a result of the exceptional service record of J-42 Turbo-Wasps which power carrier and land based squadrons of Grumman F9F-2 Panthers, flown by Navy and Marine pilots in Korea. In addition to reducing the number of overhauls, exceptional durability of J-42s has enabled the Navy to cut substantially its orders for spare engines and parts.

During the past year J-42 Turbo-Wasps logged more than 100,000 hours in the air in propelling Panther jet fighters a total of 50 million miles. Of this total, more than 20,000 hours and 10 million miles were in combat over Korea. In two years of active flying duty J-42 engines have flown more than 150,000 hours without a single turbine blade failure, and during the same time the overhaul period has risen from 150 to the present 1,000 hours.

The J-42 has performed successfully under the most rugged combat conditions since the second month of the Korean war, including catapult launching of Panthers with maximum loads of bombs and rockets; flying in heavy icing conditions; and resisting the corrosive action of heavy salt spray at sea and choking dust when operating from rough, advance airfields on land. Turbo-Wasp-powered Panthers have performed equally well as high-altitude fighters or low-level attack planes.



Evidence of the J-42's reliability under combat conditions has been its durability in face of major battle damage. Some pilots have even reported that these engines have "swallowed" rocks, three-inch tree trunks, enemy fire and varied debris without serious damage or loss of efficiency to engine output.

NEW MACHINES, METHODS SPEED PRATT & WHITNEY JET ENGINE PRODUCTION -- A program to speed production, increase worker efficiency and improve the quality of finished parts at Pratt & Whitney Aircraft has stimulated the development of several wholly new machine tools and the establishment of major improvements in metal working techniques, it was announced recently. The machines and methods will mean faster and more economical output of new high-powered axial-flow jet engines now being readied for quantity production.

The new machines were worked out by Pratt & Whitney in collaboration with several machinery manufacturers. They possess a high degree of flexibility, currently

desirable because of the wide variety of shapes and sizes of jet engine parts, and to meet requirements of the rapidly changing picture in gas turbine development. Other problems in jet engine production include working with new and tougher materials, the quantity of large-diameter thin-wall sections required, and the need for speeding up production to meet accelerated U.S. Air Force and Navy schedules.

SIKORSKY HELICOPTERS AIRLIFT ENTIRE MARINE UNITS TO KOREAN FRONT LINES --Late in September a fleet of big ten-place HRS Sikorsky helicopters flew an entire company of battle-ready U.S. Marines to an important objective atop a 3,000-foot Korean mountain peak. Thus in a single action — first of its kind in the world -- helicopters introduced brand-new tactics for warfare over difficult terrain.

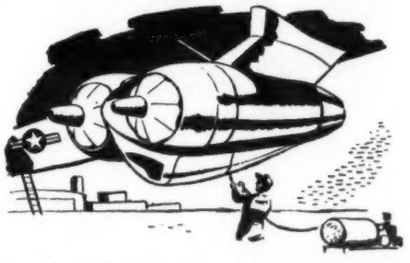
The entire operation by helicopter, including the landing of 228 fully-equipped Marines, ammunition, almost nine tons of food, and the laying of telephone wires back to command headquarters, took just four hours. Without helicopters it would have taken at least two days of mountain climbing, and during such a period the enemy might have jeopardized the success of the whole operation. As it was, the Marines were dug in and ready by the time the first enemy shot came over.

Less than a month later the largest helicopter airlift in history, consisting of 12 Sikorsky HRS helicopters, landed a full battalion of about 1,000 combat-equipped U.S. Marines to front line positions in a mountainous sector of East Central Korea. The operation, carried out almost in full view of the enemy, was unopposed, and took only 6¼ hours from start to finish -- some 25 minutes faster than scheduled.

These achievements in actual combat were the rewards for almost four years of training and research by Marine Corps planners, and of even more years of effort by Sikorsky engineers and technicians. But they more firmly than ever established the helicopter as a tactical weapon of first rank.

HAMILTON STANDARD HAS HIGH POWERED JET ENGINE STARTER -- A new line of turbine engine starters which substantially reduce the time required for starting turbine power plants has been announced by the Hamilton Standard Division. The first starter developed by the company has passed its pre-production tests and is in limited production.

Considerably lighter than electrical types currently in use, the new starters deliver over 100 horsepower. They will start the highest powered turbine now under consideration in approximately twenty seconds.



The starter, in production for the Air Force's big jet bombers, is operated by compressed air from a ground source or turbine engine. Air is passed through the starter's turbine wheel, which is connected through a gear train to a clutch. When operating at full power, the turbine, which turns up to approximately 45,000 revolutions per minute, delivers its horsepower to the engine's turbine drive. Once a single engine of a bomber has been started, it provides a source of compressed air to be fed through the starter to the next engine.

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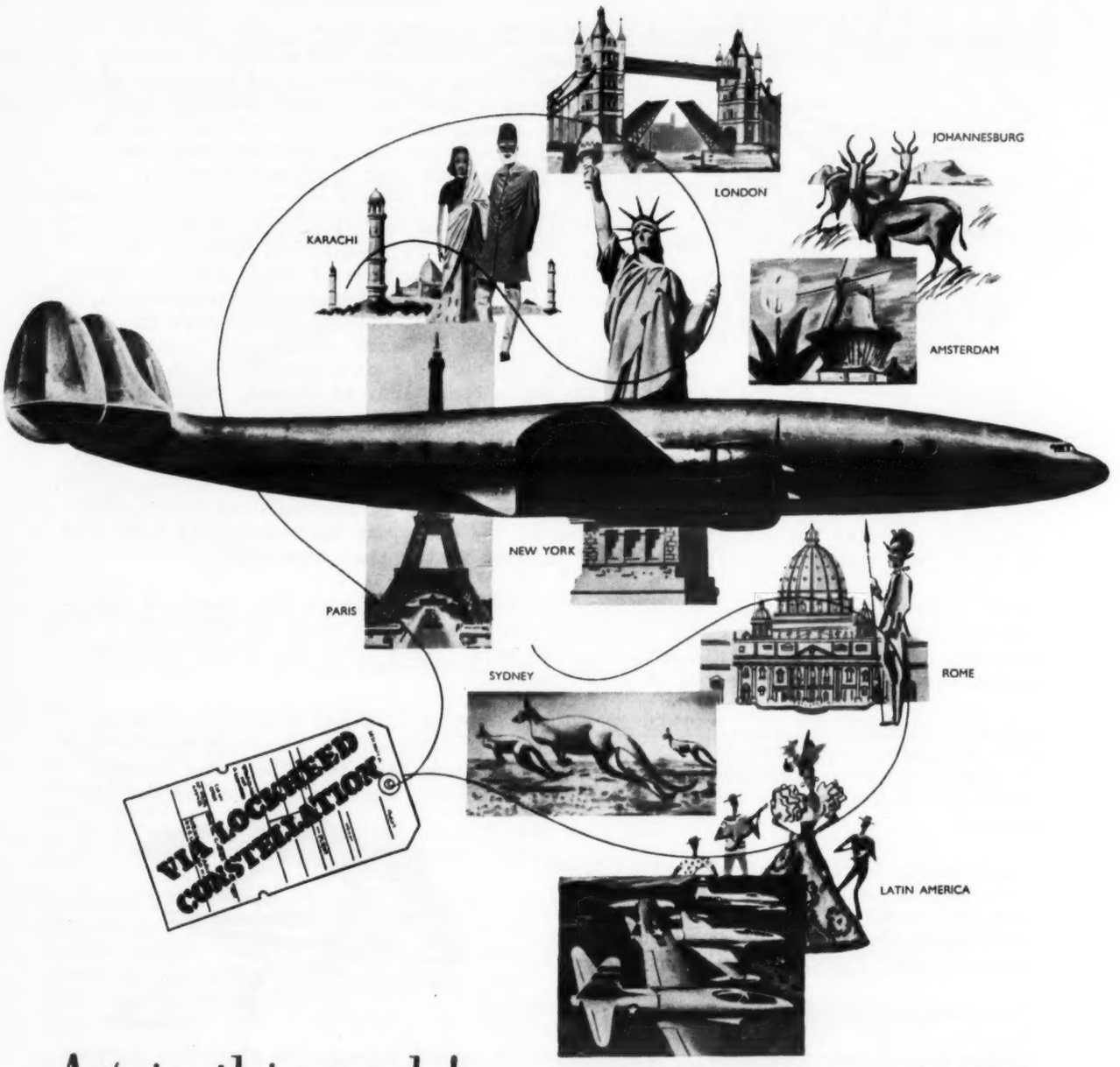

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United States — Capital Airlines, Chicago & Southern Air Lines, Eastern Air Lines, TWA.

SCIENCE OF DEPENDABILITY

Lockheed's new Electronics Building will house an advanced "Weather Laboratory", where every effect of weather can be studied firsthand... increasing Lockheed dependability."

Lockheed

Look to Lockheed for Leadership

Lockheed

BEGINS WORK ON GIANT JET BOMBER

Production of an undisclosed number of giant B-47 jet bombers has begun at Lockheed's Marietta, Georgia, factory.

As the world's leading producer of jet aircarft and modern high-speed transports, Lockheed is especially qualified to build the Boeing-designed B-47's for the Air Force. Production floor space at Marietta, plus Lockheed's California factories, makes Lockheed as large today as the entire U.S. airframe industry in 1940.

What's going on at Lockheed?

Lockheed has developed a high-speed camera with a speed range of from 1,000 to 3,000 frames a second. At 3,000 per second, a 100-foot roll of 16-mm film goes through the camera in 1¼ seconds. Purpose of the speed : to check results when fast-dropping die hits a blank piece of metal. Objective : development of stronger, new-type alloys for greater, faster aircraft.

...Another current research project creates arctic flying conditions 20,000 feet above the California desert. On an actual F-94 All Weather Jet Fighter, a spray bar shoots a fine, foggy mist on the nose and wing, building up layers of ice. Plane's de-icing equipment is thus tested in actual flight.

Past and future at Lockheed...

One of Lockheed's earlier transports, a Model 10 Electra, is approaching its 25,000th hour of flying time, in continuous service since 1937 for South Coast Airways, Pty., Ltd., of New South Wales (Australia)...

New Lockheed Super Constellations, in service by year's end, will be the largest, fastest, rangiest commercial transports in service. So well have earlier Constellations proved themselves around the world that more than 100 Super Constellations were ordered before the first production model flew... The new Lockheed-developed thin wing for the advanced F-94C—so thin it looks almost fragile—is strong enough to support two fully-loaded Super Constellations (150 tons dead weight)—one at each wing tip. This new plane, America's continental defender because of its electronic superiority, contains enough installed electrical power to supply a small community.

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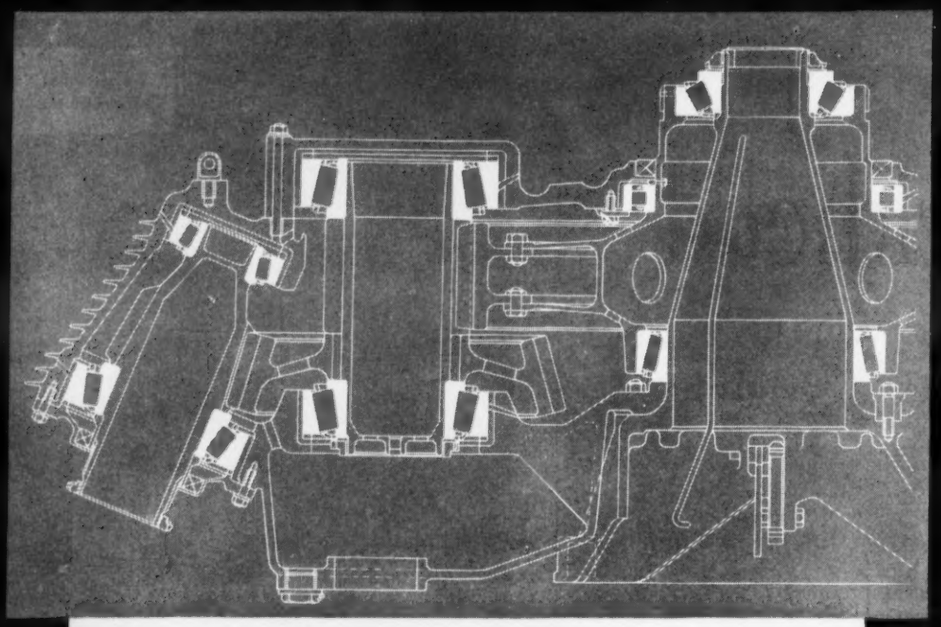


On Helicopters

Timken tapered-roller bearings, with their great capacity for thrust and radial loads, are especially valuable in helicopters. The line drawings show some present-day applications.

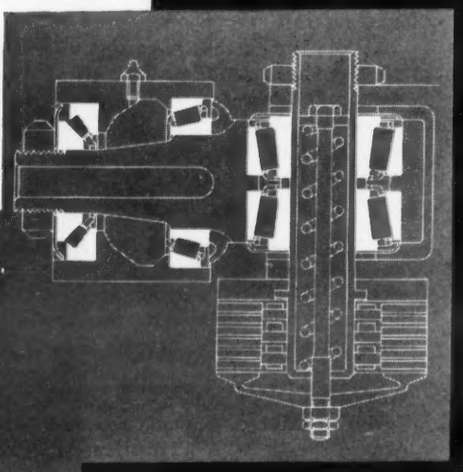
1. The rear gear box of the Bristol 173 with Timken standard and steep-angle-bearings. These bearings are pre-loaded.
2. The Saunders Roe "Skeeter" torsion and drag-link assembly with Timken standard and ultra-steep-angle bearings.
3. The secondary gear box of the Saunders Roe "Skeeter" helicopter. The pinion is mounted on a pair of Timken bearings, so arranged that the pinion can be withdrawn without disturbing other parts or the adjustment. The crown wheel is mounted in two Timken lightweight bearings, one being of the steep-angle type.

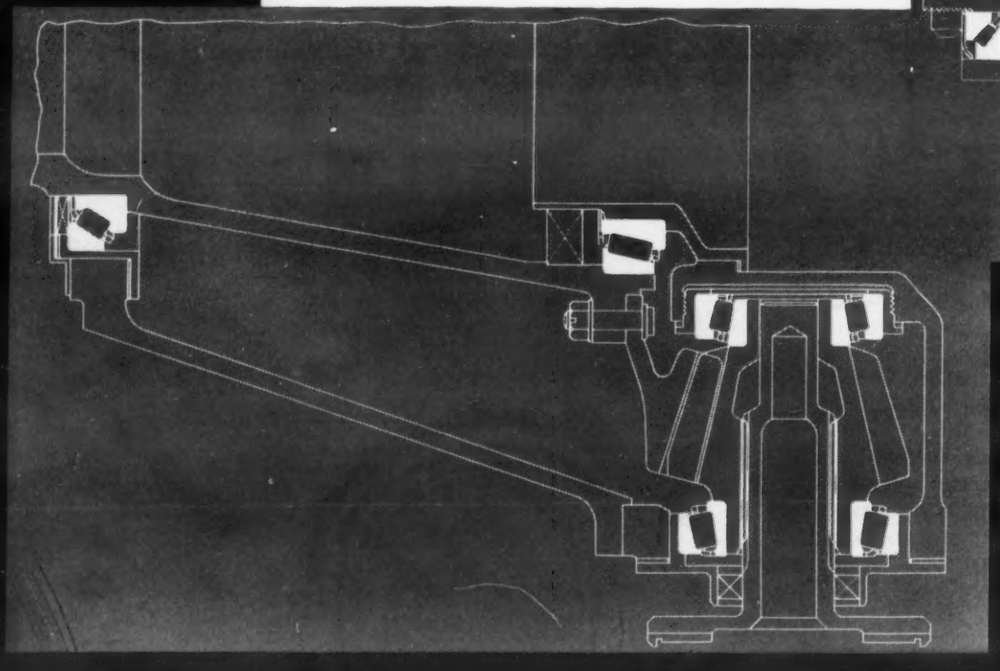
TIMKEN

Registered Trade Mark: Timken

tapered-roller bearings

British Timken Ltd., Birmingham and Duston, Northampton, England





Alfa Romeo

WINS

THOUSAND MILE AIR RACE

BARI - SEPTEMBER 23rd, 1951

Sports class

1st Guido FERRARI

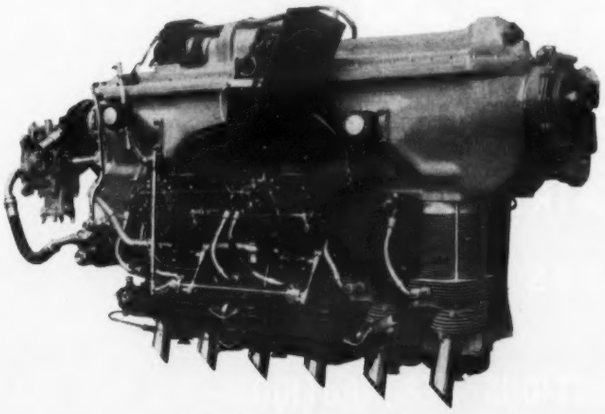
Ambrosini S.7 - Alfa Romeo 115 ter engine, which covered 1700 km in 5 hrs. 8 mins. 7 1/5 secs. at an average speed of 329,096 km/h

2nd TOMMASINI - Ambrosini S.7 - Alfa R. 115 ter.
3rd CASANOVA - Ambrosini S.7 - Alfa R. 115 ter.
4th DE BERNARDI - Ambrosini S.7 - Alfa R. 115 ter.
5th LONGANO - Ambrosini S.7 - Alfa R. 115 ter.
6th CAPONETTI - Ambrosini S.7 - Alfa R. 115 ter.
7th DI DONNA - Ambrosini S.7 - Alfa R. 115 ter.
8th SALAMINA - Ambrosini S.7 - Alfa R. 115 ter.
9th ANDALO - Ambrosini S.7 - Alfa R. 115 ter.
10th DOMENICI - Ambrosini S.7 - Alfa R. 115 ter.
11th PADOVANI - Fiat G.46 - Alfa R. 115 ter.
12th LANCIA - Ambrosini S.7 - Alfa R. 115 ter.

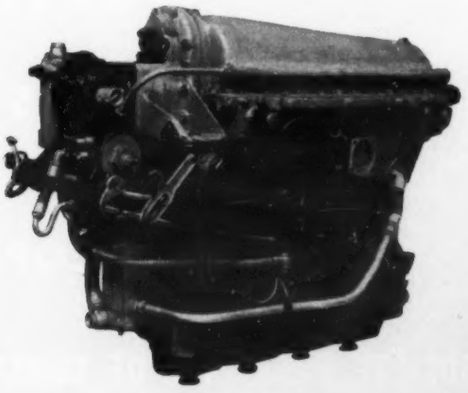
Touring class

1st Vico ROSASPINA

Ambrosini "Grifo" - Alfa Romeo 110 engine, which covered 1700 km in 8 hrs. 49 mins. 9 1/5 secs. at an average speed of 191,626 km/h.



Alfa Romeo 115 ter engine



Alfa Romeo 110 engine

CLICHÉ L.P.V.A.

S.N.C.A.S.O

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AVIONS MILITAIRES A RÉACTION

HÉLICOPTÈRES A RÉACTION

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A MERRY CHRISTMAS
AND A HAPPY NEW YEAR
TO OUR
READERS AND FRIENDS

INTERAVIA S.A.

International Air Cargo

BY SIR WILLIAM P. HILDRED, DIRECTOR-GENERAL, INTERNATIONAL AIR TRANSPORT ASSOCIATION, MONTREAL

The cargo manifest of an international airline today is like reciting the ingredients of some gigantic witch's brew—ballot papers, polar bears, currency, beer, helicopters, television parts, fountain pens, nylon stockings, cut lumber, sweaters, lions, lobsters, ship's machinery, oil-drilling rigs, sheep gut, onions, oysters, and monkeys by the thousand.

Air Cargo Today

Ever since they began operations some thirty years ago, the airlines have carried a little of the weird and wonderful in their cargo compartments, but in the past few years international air cargo has become so much of a galloping phenomenon that the airlines themselves are more than a little surprised.

In today's international airlines industry, air cargo has become what the grade B "sleeper" picture is to the cinema—an orphan child who turns up to pay the mortgage. Cargo departments whose place in many companies has been almost negligible have suddenly begun to bring in from 10 to 15 per cent of total revenues—and possibly that part of the revenue which marks the difference between solvency and trouble.

It is not that airlines are unused to expansion, for air transport itself has grown beyond even the dreams of the first operators. But where all the scheduled airlines—domestic and international—were carrying thirteen and one-half times as many passengers in 1949 as they did in 1939, the corresponding increase in cargo was thirty-one times. And figures for 44 international carriers in the International Air Transport Association who were in business before World War II give the even more astounding figure of six thousand per cent increase in air cargo between 1937 and 1950.

The impressive thing about this international air cargo development is something beyond revenues, statistics and the charm of strangely assorted payloads. It makes new areas habitable for man, lifts their standards of living from the stone age to modern civilization, opens up new markets for products of all sorts, and provides new methods of marketing and production which can increase employment and lower the price of goods to the world's consumers.

Sir William P. Hildred

Boon to Mankind

An example of what air cargo service can mean to the life of a whole nation is to be found in the three great valleys or "llanos" which make up Colombia. Separated from each other by mountain ranges, and with surface transport slow, difficult and at times impossible, Colombia has taken to the air to keep itself together as a political and economic entity.

An average plane load of cargo in Colombia includes as a matter of routine items unthinkable as short-haul air cargo almost anywhere else—vegetables, sea food, livestock, daily newspapers, concrete pipes, gas ranges and automobiles. When steamer shipping on the Magdalena River is interrupted, planters ship thousands of bags of their green coffee crop by air to the coast. Colombian textile mills distribute their cloth—800 tons of it a month—by air. And when a planter wants to go shopping, he does it by the airline's C.O.D. mail order air express service.

Flowers form a large part of routine air cargo. These are being flown from Nice to Copenhagen.

As a result Colombia's national airline is one of the heaviest cargo carriers in the world. In a year, it lifts almost 2,000,000 cargo items weighing 96,000,000 pounds. The country is bound together by the constant shuttling of 41 cargo-carrying aircraft—thirteen of them all-freighters—and air cargo service is transforming farm settlements in remote valleys into normal and productive communities in the main stream of commerce and ideas.

What international air cargo service does for areas, it can also do for products. Last Saint Patrick's Day some 50,000 Americans were flaunting sprays of the real Irish shamrock. The sprays were the product of a shamrock farm in Ireland run by an enterprising New Yorker, and the fact that these highly perishable plants could be plucked from the dewy ground of County Mayo on Monday and sold on the street corners of County Manhattan or County Cook on Friday was due only to the existence of scheduled air cargo services across the Atlantic.

Then there is the case of the Australian shoes. Rarely has there been so much leather available for so few people as in Australia, but there is also a serious shortage of shoemakers. Under the circumstances, it has been found cheaper to fly the raw materials up to Singapore for manufacture into shoes, which are then flown back to Australia for sale. (Another remedy, of course, is to get more shoemakers, and the airlines will be flying thousands of immigrants from Europe to Australia this year: but that comes under the heading of passenger traffic and is another story.)

Anyone in Hong Kong, Bangkok, Colombo and Suva who enjoys a good chicken dinner is also indebted to the airlines. Tropical chickens degenerate rapidly, and unless flocks are replenished with new stock annually, a strain of bird from a more temperate climate degenerates to half its normal size in a year. Each year now, the airlines fly in consignments of day-old chicks to start the process all over again. The process is helped greatly by the fact that for the

first 72 hours of its life, a chick or turkey poult requires no feeding or watering (and, to the infinite relief of plane crews, is corked up by nature).

Animal Passengers

A further world-wide phenomenon has been the large and growing air shipment of animals usually from the tropics, to zoos, circuses and other outlets in temperate zones. The size of the traffic can be gauged from the statement of one large airline that every ninth of its passengers has four legs, and the variety of this type of passenger would make Noah look like a grammar school zoologist.

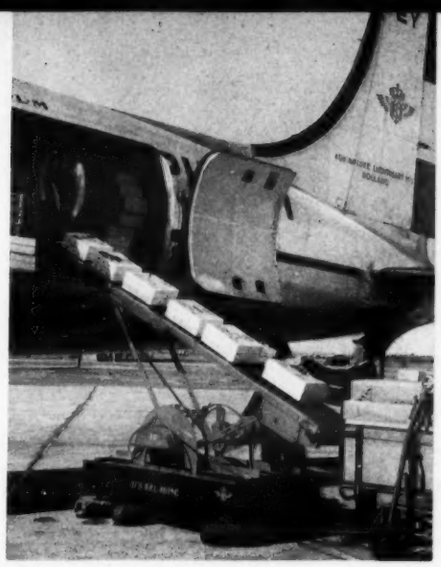
The lore which airline animal experts have developed is vast and detailed. The specialist at London Airport—who has a compound fitted for the accommodation of 20,000 animals, reptiles and birds a year—has discovered that nothing calms a monkey so quickly as a good cup of nice sweet tea (Englishmen should not draw hasty conclusions from this). Goats will be quite happy if they are bottle-fed, preferably by a female hand. Cobras are very little trouble if you give them a good meal and keep them warm. Elephants had better be watched in flight because they like to steal the food of other animals. And if lobsters pass out from the effects of altitude they can be revived by a punch in the eye.

Special or Routine Operations?

While a good deal of the cargo described so far flies in the freight compartments of the regular passenger airliner, most of it comes under the heading of special operations, justified by the absence of other means of transport, by abnormal demand for a scarce article and similar reasons. Even among the airlines the question arises whether crises and shortages can be counted upon to occur often enough to justify maintaining cargo service.

The answer is partly "yes"—and partly that air cargo service no longer has its main justification in this kind of traffic, and can look to a substantial and growing business arising out of the regular, day-to-day movement of world trade.

Steamship companies have amazingly enough become very good airline customers. It costs a steamship company about $3,000 a day in crew pay and maintenance, wharfage charges and the like, to say nothing of cargos forfeited, to keep a medium-size ship in port. When a breakdown occurs which involves waiting for some machinery part from a distant shipyard, the bills can pile up rapidly. Such breakdowns have resulted in demands for the movement of very large and heavy items of ship equipment by air. The cost of air transport may have been all out of proportion to the value of the part flown, but has run to far less than the accumulation



Fresh fruit often travels by air. KLM flies strawberries from Holland to European capitals nearly every day of the season.

of port charges would have been if the part had been sent by sea.

The demand for these large rush shipments is, of course, unpredictable, but so long as circumstances beyond man's control alter his planning, it will continue to be sizeable.

While I would not want in the least to decry these more spectacular accomplishments of international air cargo, perhaps the more interesting and more potentially important part of the story is the growing volume of goods which moves by air in the day-to-day commerce of the world.

It is this part of the air cargo business which, more than any other, seems to have come as the greatest surprise to the airlines themselves. Few airlines will seem even ruffled by the largest and most difficult special charter job, but not many were really expecting the postwar air cargo boom.

All in all, they had good reason not to. Cargo was carried before the war, but its volume was restricted by the simple reason that the price the airlines were forced to charge was not sufficiently offset by a saving in shipment time. Prewar schedules were slower, trans-shipment from one line to another was full of pitfalls, there were customs problems, payload was restricted, schedules not entirely reliable, and an airline could seldom guarantee service over any lines but its own. Customers quite rightly did not flock around to use air cargo.

With the end of the war, however, the airlines found themselves with larger planes, more reliable auxiliary services, and a network of routes which tied together most of the major commercial centres of the world and included the all-important link across the Atlantic. In the war itself, the transport of large amounts of military cargo by air had become commonplace.

"Free-trading" Pioneers

Despite these new advantages, the regular airlines did not stage a great enthusiastic rush into the promotion of international air cargo. Getting priority passenger service into the air was an overweening preoccupation. Every airline was trying in a few months to assimilate ten years of wartime development. Whatever the reason, it really remained for the free traders of Europe, the USA and the Middle East virtually to push the airlines into international air cargo.

In using the term "free traders," I must acknowledge that some of them, at least, may not have been observing all of the currency and customs restrictions of their own countries. But they were all of them bent on satisfying the long pent-up demand for consumer goods. Nylon stockings, fountain pens, watches, penicillin, more expensive wearing apparel, dressed furs and similar items could demand almost any price in Europe, just so long as they could be delivered. Air cargo was the answer to the free-trader's dream, and he started to use it with a vengeance.

This was the beginning of cargo traffic in 1946. It was mostly eastbound, from the United States to Europe. There was only a small westbound trickle, consisting mostly of Swiss watch movements, luxury textiles like silk and tweeds, borsalino hat bodies, junk jewellery and rhinestones and the like. (Jewels themselves seldom are shipped by air cargo, incidentally; they come in mainly by registered mail, or less reliably, by hollow heel.)

Once the first cargos started to flow, however, a large number of operators became alive to the possibilities of air cargo, and both scheduled and non-scheduled operators began to work intensively at developing new business. The second period of international air cargo development over the Atlantic started with the Spring of 1947 and was so experimental and tentative in its character as to be almost chaotic. No one was ready to say where cargos would come from: import-export regulations and currency fluctuations kept the situation confused; and no one was entirely certain of the economics of the trade. There was a good deal of doubt, in the early days, as to what constituted a good cargo rate—one which would attract business and yet give the carrier enough to

Caviar from Scandinavia to Paris.

pay expenses. The scheduled airlines, through their IATA Traffic Conferences, had an omnibus cargo rate which ranged from 72 cents to one dollar per ton mile, depending largely on distance, but no one could be certain how nearly this coincided with economic reality.

Non-scheduled operators took an early lead in the scramble. Their rates were not required to be part of a general pattern which included passengers and mail; they had none of the overheads of scheduled operation; and their equipment was almost entirely surplus, bought at greatly marked down prices. They could, for a time, afford to offer much lower rates than the airlines could.

Race horses are habitual air travellers, particularly between France and Britain and in Australia. This Irish one boards a KLM freighter for New York.

But this kind of operation could not last too long. Rates could cover operating expenses, but there was little left for contingencies, for depreciation, for all of the unexpected on-costs that came of a return trip empty, a cargo missed and a weather delay. The non-scheduled part of the air cargo business across the ocean reached its peak in 1948 and has since been on the wane. On the North Atlantic, for example, about 13 per cent of international air cargo now flies non-scheduled companies, while the rest goes on the scheduled airlines.

At its peak, however, non-scheduled competition forced the airlines into a reconsideration of their own rate structure which resulted in 1949 in the setting up of Commodity Rate Boards in the IATA Traffic Conferences. These boards have the virtue of fitting into the rate-making structure now approved by most governments in the world, whilst still being as flexible as possible. At first somewhat higher, these commodity rates are now at about the same level as the cut rates of 1949.

During this same two-year period, other advantages were beginning to pay off for the airlines. They had standardized a great many traffic handling procedures affecting cargo, had started the development of a world-wide system of certificated airline cargo agents, and developed a network of standard inter-line agreements that bound individual airline routes into a cohesive, world-wide system over which cargo could move easily.

Cargo-loading at Copenhagen Airport, centre for air cargo to and from Scandinavia. This shipment consists of furs from the big fur auctions in Helsinki, Finland, and is en route to the USA.

Air cargo today is still in an exciting, experimental period, but it has achieved a certain stability and maturity. An average of two full planeloads, or about 14 tons, of air cargo moves across the North Atlantic each day, while substantial amounts more fly over the Southern Atlantic routes and fan out from Europe across the globe. Some is carried on board all-freight planes, and the rest goes in the cargo compartments of passenger aircraft.

Routine Shipments are Varied

About half of the average planeload of cargo leaving the United States today is nylon stockings, bound for almost every European and Middle Eastern port. About ten per cent is pharmaceuticals and chemicals, mostly anti-biotics and biologicals. Streptomycin, in fact, could not be shipped by any other way, for it loses a large part of its effectiveness within less than two days after manufacture and must be moved quickly in order to move at all. In the same way, radioactive isotopes are sent air cargo because they lose half their effectiveness in 30 days. Isotopes are delicate cargo and one airline in South Africa has worked out a very handy way of carrying them in the wing-tips of their aircraft, well out of harm's way.

Another substantial part of this load out of America—possibly 15 per cent—consists of machinery and parts. A quarter of all machinery moved by air is for oil-drilling in the Middle East and Western Europe. Electronic equipment, which is delicate and expensive—including radiosondes used by European fishing fleets to spot schools of fish—is a particularly steady item.

An interesting aftermath of the American armies' invasion of Europe furnishes the airlines with about five tons a year of samples of American tobacco, sent over to cigarette manufacturers in Europe who are meeting the new local demand for blended cigarettes like American brands. And tucked in what space there is left, are films, recordings, blueprints, magazines, advertising material, mail order catalogues, and the host of little things called miscellaneous.

Lucrative, but often exasperating cargos are the bales of furs which head for Europe after every auction in North America. Fur buyers, for some reason, are eager to keep their business to themselves and to give their competitors as little information as possible about what they buy and to whom they sell it. Fur consignments are therefore most often identifiable only by number and the addresses of forwarding agents, while the actual shipper and consignee remain shrouded in abysmal anonymity.

A 6,000-lb. pump platform is being loaded on a Flying Tiger freighter by means of block and tackle.

An uncrated business machine travels safely by the Flying Tiger Line.

The bulk of the westbound cargos out of Europe and the Middle East are the luxury and precision goods for which Europe is famous. Silks, tweeds and knitted goods move in great volume, shipments of sweaters from Austria alone accounting for about a ton a week. There are quantities of optical, drawing, hospital and surgical instruments, thousands of little one-ounce watch movements from Switzerland, perfumes, leathers, laces, Paris dress models, millinery supplies

An Austin sports car recently made a trip around the world in 22 days. It was carried by a KLM freighter over oceans and roadless areas.

A Wright turboprop display engine goes aboard a Flying Tiger aircraft.

and the other little *de luxe* articles from the workshops of Paris, Florence, Rome, Brussels, Copenhagen and the like.

An exception to the *de luxe* importations from the east is the substantial movement by air of sausage casings from Iran—sheep gut brought down out of the Persian hills once or twice a year in sheepskin bales and transported miraculously in a few days to the meat-packers of Chicago.

So the shuttle of international trade moves back and forth over the air routes. From European gateways on to the East, cargos change in character. Surface port conditions in Iran are poor and pilferage so great that practically everything of any value, from pocket combs to refrigerators, is now flown into Teheran. A weekly service from Amsterdam to the east will carry a motley cargo of consumer items for Teheran together with gift parcels and medicines for Israel to be off-loaded at Lydda. In Iran, it will pick up carpets for the west and fill in with the personal belongings of Jews moving into Israel by Operation Magic Carpet, the airborne return from their long exile. When these are discharged at Lydda, the space is taken by textiles, pharmaceuticals and other Israeli products, and the plane is off to Amsterdam and the beginning of another weekly cycle.

But there is more to this than the recital of the oddly assorted loads which are paying an increasing amount of the airlines' bills. Behind these cargos and the rapidity with which they move are changes in the tempo and character of industry, of great significance for the future.

Air cargo has become as integral a part of the Swiss economy, for example, as the watch industry itself. Regularly scheduled service between Switzerland and the United States, the world's prime watch consumer, enables U.S. plants to keep low inventories of parts, because they have the assurance that whatever they need is only 24 hours away. They can, at the same time, distribute employment on their assembly lines more evenly around the year. And the shipper of watches is happy because he can use his short-term credit balances many times over in the course of the year.

Advantages of Air Cargo

The fact that this long list of every-day commodities can be flown profitably over long distances is the result of a number of factors. The first is speed. No product in the world today is more than five days away from market anywhere.

The second is protection. Air cargo is under constant surveillance, from the time it is picked up until the time it is delivered. It is flown directly to the city of destination, rather than off-loaded at seacoast ports and trans-shipped from one form of transport to another.

The third is lower insurance rates. An air shipment of silk cloth from Milan to New York can be insured for $90 less than the usual premium for transport by surface.

The fourth is service. Because of their own simplified systems of documentation, the airlines require less paper from the shipper and can do almost all of it for him. It can locate shipments in transit with far greater ease than surface agencies and it can provide much more personal attention en route.

The fifth is packaging economies. Commodities which must be heavily protected for surface shipment can go virtually without packaging by air. The enormous steel-bound boxes in which watches were shipped have given way to cardboard. Dresses are loaded on racks and covered with canvas: when they reach their destination, they do not even need to be pressed.

Air cargo demands young minds. The historic experience of other forms of shipping is little help and almost a hindrance. Some of the most successful air cargo departments started a few years ago with little except an advertising budget and a copy of the classified telephone book. From there on, generating air cargo was a matter of hunch, investigation and missionary work. To a very large extent, it still is.

Sometimes far-sighted growers and manufacturers will themselves investigate the potentialities of air cargo. The Dutch flower growers' cooperative, Bloemex, had a researcher in the United States for a year before they decided that cut lilac was their best product for the American market. Most often, however, new business depends on the imagination and salesmanship of the cargo man himself.

A Rosy Future

New equipment, which is the key to the question of rates, will inevitably make air shipment cheaper and even easier than it is today. Where we can now make it profitable for the shipper to send by air any commodity whose retail value is $10 to $25 per pound for shipping weight, we shall before very long be cutting deeper into the pyramid, into commodities like shoes, silverware, and the like whose value is as low as $5 per pound.

I do not expect that we will ever, as a normal thing, carry the sort of cargos which are loaded in the holds and the between-deck spaces of steamships. But I am certain that in any time now, the airline cargo plane will inspire some future poet to write an aerial version of Masefield's verse on the five-banked galley:

"Quinquiremes of Nineveh from distant Ophir,
Sailing home to haven in sunny Palestine,
With a cargo of ivory,
And apes and peacocks,
Sandalwood, cedarwood, and sweet white wine."

We carry all of these commodities today at competitive rates. And, if necessary, we'll lift the quinquireme as well.

Air Cargo Makes the Grade

Difficult Adolescence

Air cargo is a post-war phenomenon and certainly the most exciting development in the field of transportation of the last ten years. But air cargo is still in a state of adolescence—and a struggling adolescence at that. As yet it is a thin sliver of overall airline operations and represents only an infinitesimal fraction of freight transportation as a whole. In 1947, for example, domestic air cargo operations in the USA totalled 127,000,000 ton-miles (this figure increased to more than 150,000,000 ton-miles by the end of 1950), whereas in the same year domestic railroads, motor carriers, pipelines and inland waterways (excluding coastal cargo ships) transported 900,000 million ton-miles of freight.

Not only is air cargo an adolescent, but it is also passing through its heroic years—just as the passenger airlines lived through a heroic age up to the middle thirties. It is still labouring with tools primarily fashioned for passenger traffic. Present-day air cargo handling facilities are nothing short of primitive. Few airports offer adequate warehousing or cooling facilities. Airport and airline management has been slow to instal mechanical cargo handling equipment. Pickup and delivery service has been inaugurated only relatively recently; it is expensive and sometimes slow. The major working instrument of air cargo—aircraft—has not been designed for its specific purpose. It is astounding that, barring a handful of minor exceptions, aircraft specially designed for cargo are *not* in commercial use today; cargo aircraft are either adapted from passenger transport designs or actual passenger aircraft of obsolescent vintages diverted to cargo operations. Only a small percentage of the world's fleet of commercial transports is used for all-cargo purposes. No wonder present-day air cargo is expensive. As long ago as 1948 a top official of Curtiss-Wright Corp. estimated that one small factor alone, namely, the lack of standardization of aircraft loading floor levels and those of truck beds or loading docks increases cargo handling costs by $2.50 a ton!

Air Cargo Saves Money

In spite of these handicaps, air cargo has secured itself a firm and expanding rôle in the overall transportation set-up. Even in its present imperfect state of development it saves money by its speed: it accelerates the turnover of money tied down in a product en route from manufacturer to buyer; it saves money on insurance, packing and other items; and in certain cases it can turn a dead loss into certain profit. A pertinent example of the latter point is illustrated in a study on "Domestic Air Cargo" published at the end of 1948 by the U.S. Civil Aeronautics Administration. It shows that air cargo substantially extends the marketing time span for perishables at distant markets. For airborne Californian fruit and vegetables the marketing time in Chicago increases by anything between 100 percent and 400 percent compared with rail express and rail freight:

Commodity	Marketing Days when Transported by: Air	Rail Express	Rail Freight
Cherries	13	10	6
Apricots, Figs, Broccoli, Spinach, Nectarines, Cantaloupes	9	6	2
Plums, Asparagus	11	8	4
Strawberries	9	6	0

Rapid Growth

It was World War II, with its vast aerial logistics support operations, which aroused a reluctant air transport and industrial world to the potentialities of air cargo. Figures compiled by the International Air Transport Association illustrate the growth of scheduled cargo operations by scheduled carriers on domestic and international services since the war:

1937 :	15,000,000	ton-kilometres
1947 :	300,000,000	» »
1948 :	460,000,000	» »
1949 :	570,000,000	» »
1950 :	760,000,000	» »
1951 :	900,000,000	» »
(estimated)		

These figures include all forms of commercial payload other than passengers and mail, namely, air freight, air express, diplomatic cargo and excess baggage. Approximately 80 percent of the total was carried by IATA members.

Unfortunately, no statistics are available concerning the amount of cargo carried on charter operations by scheduled carriers and those intrepid post-war air cargo pioneers, the non-scheduled carriers. These operations may increase the totals for the more recent years by as much as 20 percent. Here it may be recorded that the "non-skeds," of which hundreds sprang up all over the world after the war, probably carried more air cargo than the scheduled operators in the first years of peace. Many of them lost their shirts in the ensuing cut-throat competition, hundreds were gradually pushed to the wall by Government regulations and the increasingly efficient and reliable operations of the regular lines.

The picture is somewhat different if air cargo is measured in terms of tonnage carried rather than ton-kilometres performed. In parts of the world where surface transport is relatively undeveloped, air cargo has become the normal means of transporting goods. These mountain-hopping and jungle-crossing operations account for a large part of tonnage carried but for only a small part of ton-kilometres performed. In assessing the *economic significance* of air cargo, these varying factors should perhaps be given greater prominence. However, if we look at the matter from the point of view of *revenue earned*, the correct measure is in terms of ton-kilometres.

Tons and Ton-miles

Both measures of cargo traffic are given in the table below. It shows the thirteen largest scheduled cargo carriers of the world in descending order of magnitude, expressed in ton-kilometres. Where possible, figures are also given for tonnage carried. It will be seen, for example, that Colombia's AVIANCA, while very high in any list of "tons carried," does not rank among the first ten on a "ton-kilometres" basis. Another example is BOAC, which carried only 4,500 tons but accumulated over 29,000 ton-kilometres, since the average distance flown per ton was 6,500 kilometres!

World's Major Air Cargo Carriers, 1950

Airline	Ton-kms. (000)	Tons carried	Av. Distance carried (kms.)
1. American Airlines	67,351	66,000	1,020
2. Pan American Airways	66,121	25,500	2,600
3. United Air Lines	56,453	45,000	1,250
4. Slick Airways	52,158	...	...
5. Trans World Airlines	45,099	23,700	1,900
6. Air France	32,615	26,300	1,240
7. British Overseas Airways Corp.	29,233	4,500	6,500
8. Flying Tiger Line	28,328	...	...
9. KLM-Royal Dutch Airlines	25,212	10,000	2,520
10. Eastern Air Lines	23,939	22,000	1,090
11. Northwest Airlines	23,222	15,500	1,500
12. Australian National Airways	20,334	30,000	680
13. Avianca	18,925	43,600	430

The above 13 carriers account for approximately 65 percent of cargo ton-kilometres performed in scheduled operations. The first five of these take care of nearly 40 percent of the world total.

The figures for total cargo traffic quoted earlier show that the rate of growth of cargo traffic in the post-war years has not been tapering off: in other words, there is no suspicion of air cargo reaching its maximum degree of expansion in the foreseeable future. The highest percentage rise (over 50 percent) took place in 1948, as compared with 1947. In 1949 the rise was 25 percent over 1948, but by 1950 it had again increased 33 percent over the preceding year, and there is every indication that the 1951 increase will be almost identical.

Cargo Catches Up

This high increase in cargo traffic has also led to an increase in the proportion of cargo to other types of air traffic. For example, a survey based on the experience of forty IATA members indicates that air cargo in 1950 accounted for 20 percent of total ton-kilometre load, as against 12 percent in 1947 and 7 percent in 1937. Complete figures follow:

Percentage Distribution of Load

	1937	1938	1947	1948	1949	1950
Passengers	80	72	82	78	77	74
Cargo	7	9	12	16	17	20
Mail	13	19	6	6	6	6

This percentage distribution does not imply a similar distribution as far as revenues are concerned. Because cargo rates are still largely at an experimental and creative stage, it is inevitable that cargo revenue per ton-kilometre should be lower than passenger and mail revenue. As a rough estimate, cargo at present accounts for 12 to 15 percent of airline revenues. This overall figure (which refers only to cargo revenue earned in scheduled operations) conceals many individual variations in airline experience. Many carriers do not derive more than 5 percent of their revenue from scheduled cargo operations. Against this, some South American carriers show a proportion of 25 to 30 percent.

Of some interest are figures for cargo traffic on the North Atlantic routes, which form the most heavily travelled intercontinental air lane. The tonnage carried across the Atlantic by scheduled airlines is as follows for the last two years for which figures are available:

North Atlantic Air Cargo Tonnage

	1949	1950
Eastbound	3,078	3,445
Westbound	2,313	3,361
Both ways	5,391	6,806

Expansion is not uniform

The growth of air cargo has varied considerably according to geographical areas. In regions with poor surface transport the post-war availability of larger and more efficient aircraft has stimulated air cargo to relatively more sudden and sometimes spectacular growth. This applies particularly to Australia and certain South American countries. It is also true in the case of the USA, with its great distances and widely separated consumer and manufacturing centres. Curiously enough, in the case of two nations with far-flung possessions, France and Britain, the relative increase is by no means comparable, as is shown by the figures given below: the figures for the USA represent express and freight ton-kilometres performed by domestic regular airlines; the British figures the performance of all British scheduled services, domestic and international; and the French figures the cargo ton-kilometres flown by all French air carriers, Government-controlled and private (*i.e.*, including scheduled and non-scheduled traffic). For France and Britain 1938 is indicated as the last full pre-war year, whereas the U.S. equivalent was 1940.

Regional Air Cargo Development
(thousand ton-kms)

Year	USA	Great Britain	France
1938	...	1,586	1,022
1940	5,075	1,526	—
1946	56,372	12,828	6,974
1948	148,010	25,378	44,177
1949	123,002	29,565	51,251
1950	220,973	35,820	54,944

This discloses that two air cargo systems operating under completely different conditions (USA and France) have shown a similar development, since U.S. domestic air cargo ton-miles performed in 1950 increased about 44 times as compared with the last pre-war year and French domestic and international air cargo of 1950 grew to nearly 54 times that of 1938. On the other hand, the two systems operating under similar conditions (France and Britain) developed differently, since Britain, with Empire liaisons even vaster than those of France, recorded an increase of less than 23 times the 1938 figure. However, the latter comparison may contain the seed of a fallacy, because the British figures, unlike the French, take no account of non-scheduled operations.

Expressed in tons of cargo uplifted, the growth in France's total air cargo has also been more spectacular than that of scheduled British air cargo. The following table bears this out.

French and British Air Cargo Tonnage
(Metric Tons)

Year	France	Britain
1938	1,403	2,530
1946	6,187	4,147
1947	13,694	5,132
1948	32,146	8,238
1949	43,587	14,390
1950	44,460	19,642

What Goods are Air Cargo?

The question "What travels by air?" has provided an opportunity for a great number of interesting studies. In general it has been assumed that those commodities which benefited most by the speed of air transportation would make the most suitable air candidates. Because of the relatively high level of air freight tariffs these would in most cases be high-value, low-bulk items. In 1942 C. G. Peterson, Chief Engineer of the U.S. Railway Express Agency, in a comprehensive analysis of air express, concluded that, by and large, the commodities which moved by air were those which related to the speeding up or functioning of an industry, rather than consumer goods.

Taking the USA as the most air-cargo-minded example, this summation held to 1945. Until the advent of all-cargo operations, the only types of consumer goods which moved in large volume were such graphic arts products as newspapers, magazines, etc. By 1947, however, consumer goods represented a formidable proportion; textile and apparel goods amounted to 11.8 percent of the total payload of scheduled U.S. carriers and 48.5 percent of the tonnage hauled by non-scheduled operators. Hardware and machinery accounted for 32.5 percent and 27.1 percent, respectively, graphic arts products to 7.8 and 0.6 percent; agricultural products to 7.6 and 16.5 percent.

As airfreight continued to expand, this pattern of commodity distribution began to change. More and more shippers were finding it advantageous to use air cargo. A wide range of items formerly not considered as potential air cargo began to move by air. The result was a decline in the relative proportion of the total cargo represented by articles which during the first years had made up the great bulk of the traffic. Thus, wearing apparel, textiles, dry goods and horticultural products which in September-October, 1947, had represented 44 percent of all domestic U.S. air freight accounted for only 32 percent in September, 1948.

Today it is safe to state that anything can travel by air—with the exception of such low-value, bulky materials as ores, coal, etc., although coal moved in quantity on the Berlin Airlift of 1948-49—ranging from livestock to fresh food and furniture.

Future of Air Cargo

Thus the future of air cargo seems assured. Its growth will certainly be accelerated as better facilities and handling methods come into use, making the air movement of goods faster, cheaper and more reliable. Informed opinion in America estimates that domestic U.S. air cargo traffic will equal that of domestic air passenger traffic by 1955. Using a simple formula, the CAA comes to the conclusion that by 1955 domestic air cargo will reach a total of 1,150,000,000 ton-miles (or, assuming an average haul of 1,000 miles, an aggregate weight of 1,150,000 tons). As domestic air cargo totalled 151,351,080 ton-miles (220,972,577 ton-km) in 1950, it will have to increase only seven times in five years to reach this goal. Quite possibly it will succeed... and air cargo in other parts of the world will hardly lag behind.

Building up an Airfreight Line

BY ROBERT W. PRESCOTT, PRESIDENT, THE FLYING TIGER LINE, BURBANK, CAL.

Robert W. Prescott was born in Fort Worth, Texas, in 1913. He enrolled as a cadet in the U.S. Navy at Pensacola, graduated as a pilot at the end of 1940 but resigned the next year to go to China with the "Flying Tigers," the American Volunteer Group. He joined TWA as a pilot at the end of 1942 but after a year returned to the Orient as a pilot of China National Airways, flying supplies across the "Hump" into China. Back in the USA in December, 1944, he first assisted in the building up of a new airline company in Mexico. In June 1945 he established "The Flying Tiger Line," handled the organization of finances and instituted the company's present operational plan.

World War II Lessons

The airplane has been used for the transportation of property just about as long as it has been flying, but except for some isolated instances in various parts of the world, such as the bush country of Canada and some parts of Central America, it has been primarily employed to transport passengers.

In the United States, it was generally regarded that the country's fine highway and rail systems made the airplane, with its high cost and limited volume, impractical as a freight carrier. This was true until the outbreak of World War II. During the war it became vitally necessary to establish air transportation that would match the speed of the fighting and bombing air forces. The largest and most spectacular demonstration of the freight-carrying possibilities of the airplane occurred in the operation across the "Hump." There we had to get large quantities of all kinds of war material over an almost impassable terrain. Millions of pounds of such supplies were moved.

Those who were in that operation saw that the airplane could carry large amounts of freight successfully and could do it far more cheaply than the passenger lines had charged for air express traffic in the United States. That traffic, called "Air Express," was confined to small packages, and had been going on some years before the war.

So it was that in 1945 we returned from the war with more knowledge and demonstrated facts concerning the air movement of goods crammed into our heads than could have been gained in twenty years of normal operation. We were fresh from eating, sleeping and living air transport for nearly five years and we returned with a hearty enthusiasm to continue in that field as our means of earning a living.

Our survey of the air transport industry revealed that there was little room for us in the field of air transportation of persons or mail. The potential seemed adequately served. There appeared, however, one field in which none of the existing carriers had evinced much interest, and that was the one field which, because of the circumstances of war, we knew more about than anyone else. That was the movement of goods on a large-scale basis.

Air Cargo a Novelty

A look at the tariffs on file at that time revealed that if a shipper wanted to move his goods by air, he did not go to any airline —none of them had any tariffs filed for property shipments. He had to go to the Railway Express Agency. They accepted his shipment, collected for it and were solely responsible for its safe delivery. The goods moved as Air Express, and the rates were at a level of about 70 cents per ton-mile, which was more than four times the highest existing surface rates. Also, the shipper had no choice of airline or air transport companies over which to move his goods. This was done for him by the Railway Express Agency.

We surveyed this situation, took our pencils and figured that we could move goods at something less than 20 cents per ton-mile —by doing business directly with the shippers. How much less we could not tell because there was no backlog of information anywhere to guide us. Now some transcontinental rates fall as low as 8 cents per ton-mile in the United States.

So we decided to form our companies. The *Flying Tiger Line* (which gets its name from the American Volunteer Group in China, or the "Flying Tigers," which was formed in 1941) happened to be the first all-freight air operation in the United States. Other companies, also sponsored by veterans from the war, followed, and within two years' time there were some 300 freight and contract operations in the United States. As in any other field, the price of pioneering has been hardship, tragic financial losses and broken heads. Today, only two transcontinental all-freight carriers remain, Slick and Flying Tigers. The reason for that is government regulation, which we will examine shortly.

We were fully aware when we entered business that the government was already supporting the airline industry with payment of government money to the carriers ostensibly for carriage of the mail but actually with indirect subsidies at rates far above any the public would pay for airmail. The

A "Flying Tiger" Douglas C-54 air freighter.

government, in the interests of national defence and in its historical rôle of advancing the nation's transportation needs, undertook this job just as it had done for the railroads and steamships until they became self-supporting.

It was plain to us that the government would not be interested in underwriting the operation of still another airline, no matter what we carried. We felt, however, that we could be self-sustaining if we approached the problem on a practical basis.

We talked to a great many people who ship goods—dress manufacturers, fruit and vegetable and flower growers, manufacturers of all kinds of goods and machinery, retail business houses and even morticians. They had never been approached with such an idea, fast transportation of goods at low rates, and they were, almost to a man, eager to see us start it.

Early Struggles

Looking back on that summer of six years ago, when we incorporated this airline, we now know that it was with an amazing naïveté that we went into business. We were starting down a long runway to bring airfreight to the American public. Naturally, we were not received with open arms by the aviation industry itself. But the fact that we are here today is good evidence that in America, if you have a feasible idea and work hard enough at it, the people will eventually recognize and acclaim your worth in their scheme of living.

At first, we attempted to develop airfreight by contract operations, which means flying when you have a load under contract to specific shippers. This did not work. We learned quickly that the shipper needed constant service, at specific times, at specific rates, which is to say, *scheduled service* at published tariff rates. This could be accomplished only if the government would give you a certificate of convenience and necessity.

The passenger lines resented this intrusion of a new group into a field which they regarded as their own, to develop as they saw fit. Our position simply was that the passenger lines had done nothing about freight and had no real plans for it. We contended that companies devoted primarily to the carriage of freight would do the most and the best job to develop it.

This position has since proved true. Today, the two major transcontinental freight carriers, Slick and Flying Tigers, are transporting more freight than the five major passenger carriers combined. Because of the relatively large amount of traffic that came to us in the first two years of operation —I say relatively because today's traffic is six times the volume of those days—the Civil Aeronautics Board granted our application for a Certificate of Convenience and Necessity. The results in the two years which have elapsed since certification in August, 1949, have been encouraging. In our company, our ton-mile traffic has tripled. This has resulted from such programmes as the institution of *directional commodity rates*, as well as the creation of the world's largest airfreight and contract air fleet.

Rate Structure

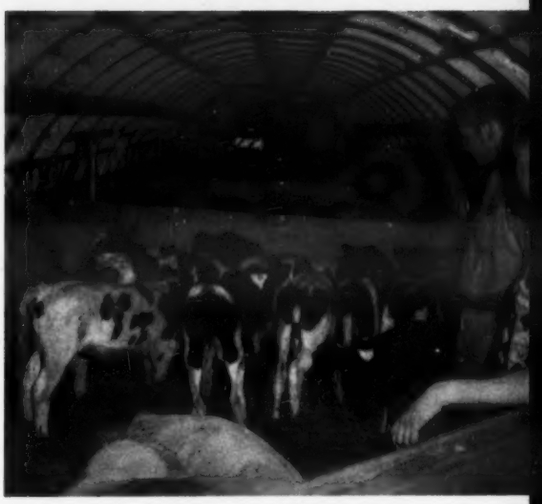
Airfreight rates in the United States are segregated into four groups: general commodities, specific commodities, premium commodities, and directional commodities. General commodity rates apply to all freight not specifically enumerated in the three other groups. Premium commodities are those for which rates higher than the general rates are charged because of extra handling or care which may be necessary. Such commodities are animals and human remains. Specific commodities are those for which rates below the general rate are charged to attract traffic that otherwise could not bear the higher rate.

Directional commodities are those which are carried at rates below the basic minima prescribed by the Civil Aeronautics Board. These rates are designed primarily to overcome the backhaul problem. In the United States, there is a preponderant flow of traffic from the heavily-populated Eastern sections to the less populated West. In order to balance out traffic loads and make it financially possible for a carrier to put in traffic-developing service, or enough service to meet shippers' demands, the government has permitted us to set up these directional rates, some of which are nearly 40 per cent below the general rates. All carriers may take advantage of such rates, or they may charge more than the minima set by the government. None may charge less.

These directional rates have produced large amounts of traffic. For example, nursery stock traffic amounted to only a few thousand pounds a year before favourable rates were applied. Now this traffic runs into hundreds of thousands of pounds. Admittedly, these rates do not pay their way in the total cost structure of the carrier, but they cover enough of the direct operating costs so that the profit made on other traffic enables the carrier to show an over-all profit on a volume operation.

Expansion and Improvement

Certification in 1949 enabled us to go forward with the expansion necessary to attract freight to the airline. Our fleet increased from six aircraft to 35, which enabled us to put in the frequency of service needed to move goods in quantity and on schedule. From two transcontinental schedules, we expanded to six per day. We put in two regional schedules to handle heavy, short-haul traffic between Eastern and Midwestern points. Finally, we exercised operating rights to 43 cities in place of the eight we had been serving; these embrace most of the principal manufacturing centres.



Carrying calves in pens—100 to an airplane.

One major reason for our success was that we undertook to serve the user of freight on the basis of strictly a freight operation. For instance, since we carried only freight, shippers quickly found that their goods did not have to compete for airplane space with passengers, mail and express in times of heavy traffic. In fact, the traffic manager of one of the nation's largest manufacturing companies told us that the principal reason he used airfreight lines in preference to passenger lines was because he could count on a shipment "coming straight through once it is on your plane." Passenger lines, confronted with heavy mail, passenger or express loads en route many times would have no choice but to off-load freight.

We put in such improvements as an advance manifest system, which enables a station to tell instantly whether any freight is en route to that station from any other station for any particular shipper. This is done by transmitting by teletype a complete manifest of the freight loaded by any one station. The manifest is transmitted at the time the flight departs so all stations are promptly informed of what freight is en route to them, from which shippers and to which consignees.

We discovered advanced means of loading aircraft so that we could handle freight which other airlines refused. We found out how to handle certain types of freight which other carriers had banned, and we geared our operation so it could act quickly in emergencies to meet the service need of shippers confronted with plant crises.

"We Haul Anything"

One major step which we introduced, and directly as a result of our experience in the war, was heavier loading of our aircraft. We beefed up flooring and landing gear

and thus made it possible to haul heavier loads. On our C-54s, we carried in excess of 20,000 pounds, compared with passenger line restrictions set at 16,000 pounds. More payload made a better operation for us, it moved more shippers' goods sooner and enabled us to carry larger individual pieces of freight.

We operated on the principle that if you could get your freight in the airport gate, we could haul it. We told salesmen: "Never turn down a pound of freight." We advertised that we could haul anything, anytime, anywhere and I think we have come pretty close to doing that.

That resulted in some embarrassing as well as amusing experiences, such as the time a salesman sold a commercial fisherman on shipping swordfish to New York, unfrozen! We did it, all right, but after our cargo handlers got through loading 600-pound, 12-foot swordfish in the aircraft belly, they knew exactly how slippery a fish could get, and several of them had to go to a public bath before their wives would let them in the house!

The point is, we did it and that was all the shipper was interested in. We soon discovered he never wanted to hear about our problems. He had plenty of his own. If we solved them, we got his business. One of the things that makes us confident is the great number of large firms which have now been on our books as customers for nearly six years.

During all this time, while we were trying to discover the key to making the freight business pay, we had to stay in business. To do that, we found it necessary to employ our capital, plant and equipment in every possible way.

We went out and solicited outside maintenance business from other carriers and plane operators. Since we had to have a maintenance force for our own aircraft and since we couldn't keep that force busy all the time, we sought other like work to help pay the cost. Now work of that kind brings in more than a million dollars a year in revenue.

Everything Helps

We couldn't afford to have airplanes sitting on the ground, so we hunted up people who wanted to charter them for special flights. We hauled special parties, athletic groups and finally began chartering some aircraft to the newly-established air coach operators.

We found out that in distant lands there was a great need for transportation of the kind we could provide. We began carrying displaced persons from all parts of Europe and Asia to the United States, to Australia, to the Middle East and to South America. We helped other people with the air coach idea to put it into operation across the Atlantic to Europe and back, carrying students and tourists. The day is coming when air coach traffic between Europe and America will be one of the greatest transportation sagas of the age. Make it cheap and good and the whole world can use your service instead of a privileged few.

We carried cattle to South America, race horses from London to New York, nylon hose from Philadelphia to Amsterdam, sausage skins from the Middle East to New York—we took whatever we could get so long as it paid something toward getting the airplane back. If you get in the habit of looking for freight that way, it is surprising what you can find and how many people will come to you to solve their transportation problems.

This year, we've carried illegal immigrants back to Mexico, farm labour from Puerto Rico and various parts of the southern United States to northern agricultural areas, and troops throughout the United States. Across the Pacific to Tokyo, we've carried millions of pounds of war material and thousands of soldiers. Part of the job is freight, part of it is passengers.

The point is, all of this has contributed importantly to gross revenue—revenue that we had to have to promote the airfreight business. Since airfreight couldn't pay its way until the past year or so, either you had to get other revenue or you had to have some very rich friends. We didn't have friends who could sink millions into pioneering an idea, so we went out and tried to get our money where we could find it.

It was a good thing for us, too. It made us understand that you could run a business without the plush effects that are so common to airlines. Our offices are simple and unadorned. We get them in inexpensive locations and furnish them simply. That way, your personnel gets in the habit of working in simple, practical ways and there is nothing I know of that is more simple and practical than a piece of freight, and the shipper usually looks at it that way and expects to pay for it that way. He likes to travel well, himself, but an aerial boxcar is sufficient for freight.

Time is Money

In the development of the airfreight industry, we tend to lose sight of the fact that the single most important job of an airplane is to save time for the user of airfreight. True, the airplane does other things for the buyer of freight space. Sometimes, it saves him extra crating and packaging; additional insurance; or it overcomes a physical barrier.

But most important of all, the airplane saves time.

We in the airfreight industry are now beginning to attempt the same job that the nation's passenger lines have done in selling the air passenger. Our objective is to make the user of airfreight time-conscious.

In some respects, this is a more difficult job. A man can argue about the value of his time. A piece of freight needs someone to speak for it. To sell a man upon the dollars he will gain by saving time on his freight means a cold, unemotional analysis of the costs involved. These are difficult figures to get. In fact, in most instances they are unknown.

In a recent survey of manufacturers, we were unable to get, with few exceptions, the cost of shipping, packaging, warehousing, interest and insurance per unit of production. We discovered that most manufacturers did not have these costs.

Now if this is true, picture how much more difficult it is to get an analysis of what it means in dollars and cents to cut down

Unloading a 6,000-lb. power transformer from a Curtiss C-46 "Commando" freighter with power crane equipment.

drastically the idle in-transit time of merchandise.

In selling airfreight, we believe that somebody is paying for the time expended to get a product from the factory to the consumer. When the product is being fabricated, somebody is paying for the material and labour costs involved in getting the product ready for market.

Once the product has been finished for market, it must be transported to the market. Somebody pays for this transportation cost but somebody also pays for the time the product is in transit. Someone's money is tied up in that product until it finally reaches the hands of the consumer.

Now if the airplane can do an effective job of cutting down this in-transit time and do it at a reasonable cost, somebody is going to save money.

That is exactly what is happening today in air passenger transportation. People are paying money to save time—time for leisure, or time for more business. The same fact can be applied to freight.

It is here that the great opportunity lies in airfreight and, as we make the rates for airfreight more attractive, more and more industry is going to use it.

Initially, they are going to use it because it costs only a little more and you get it there sooner. But some day, business will sit down and figure out just how much airfreight saves by saving time. It is not improbable in our view that the day will come when the purchase of time saved by air transportation may be almost as great a factor in the efficiency and lower unit costs of industry as the discovery of mass production was 100 years ago.

Conveyor system loading power saws.

This may be especially true when we get airplanes that will carry two and three times as much volume per airplane as today's aircraft at half again the speed and at rates 20 to 50 per cent under today's freight charges.

Outlook for Tomorrow

Today's freight airplane is a make-shift vehicle of the air. It was not built for freight. It was built for passenger traffic. Manufacturers now are beginning to design freight airplanes—airplanes that will carry loads up to 50,000 pounds at 300 miles an hour; engines that will achieve that speed with less fuel costs; airplanes that are simple and therefore less costly to maintain.

The day probably is coming when the cargo cabins of aircraft can be detached from the power units and loaded or unloaded separately while the power unit, like the truck tractor, picks up a loaded cargo airvan and transports it elsewhere.

This is the job the airplane is built for. While it accomplishes other savings for business, such as less packaging, lower inventories, reduced warehousing, less insurance and greater distribution; while it crosses physical and political barriers in many parts of the world which cannot be surmounted by surface means or only at great cost, the airplane's primary advantage still lies in the realm of time saved.

How to Run an Airfreight Line

BY THOMAS L. GRACE, PRESIDENT—SLICK AIRWAYS, INC.

A story on *How to Run an Airfreight Line* would take volumes. Airfreight is now big business and is run by efficient methods gained through years of experience and through study of the efforts and errors of other forms of transportation, business and industry. Many attempts have been made to run an airfreight line, and many have failed. It follows that in the air freight business the management must—as any management should—keep a very careful watch on costs if it is to build up an efficient and profitable organization.

Thomas L. Grace, President of Slick Airways Inc., joined the company in August 1946 as Superintendent of Space and Flight Control. He had had 12 years' experience before the war in commercial aviation as a pilot and instructor. During his tour of wartime duty with the U.S. Army Air Forces he served as Operations Officer for the East Bengal Wing of the USAAF Transport Command in India, directing the flying of supplies over the Himalayan Hump to China.

Analysis of Cost and Revenue

A system of tight cost control has therefore been set up within the structure of Slick Airways, which gives management the information it requires to make decisions of policy at strategic times. A clear picture of the various functions in the organization is presented daily in the form of reports which are analysed individually by officials of the company. Through discussion, meetings and conferences the results of individual thinking are moulded into what then becomes a single idea of management. This idea or decision then becomes policy. It is a result of collective thinking; a function of management.

A daily report to management, which is possibly as important as any, is that which includes the load factor and utilization of aircraft and volume of freight handled. Through analysis of this report, anticipated profit may be established, allowing management to arrive at decisions which will make for a daily profitable operation. A figure which represents daily standard performance

is reached, and through comparison with this figure, management is made cognizant of the degree of efficiency with which the organization is functioning.

Another report which reaches management monthly is that which shows the "mixture" of freight handled. The carriage of hard freight which produces high income must, of necessity, balance seasonal commodities, such as fruits, vegetables and flowers. Very close checking and constant contact with the salesmen in the field is a result of this report. So as not to be duped by high load factors, utilization and volume, which of themselves constitute excellent business indications, this report augments others to indicate actual revenue.

There are reports received giving information on inbound and outbound tonnage from every station on the system. Pick-up and delivery schedules and costs are broken down and analysed by carrier. Wage reports show daily overtime and double-time expenditures. Any unusual conditions are normally brought to the surface through this report. Graphic illustrations are kept up to date to show the position held in relation to competitive groups.

There is a semi-monthly analysis, by shipper, of all shipments made. From this it is possible to know the major sources of business and to open the field for salesmen to approach others in the same industry who are not using airfreight.

There is a 10 a.m. analysis on expenditures of the previous day, together with total receipts. Also, a daily analysis of accounts payable.

A daily report to management reveals the gas tax situation in the various states in which we purchase gasoline. Gasoline is the largest single expenditure (excluding salaries) of an airfreight company. The report gives to management the volume of gas purchased at the various stations throughout the system and points out favourable points at which to make these purchases. Due to local price differences, varying state taxes, the varying refunds connected with state taxes, the analysis of a report of this nature will show savings available up to 1.5 to 2 cents per mile.

Details of sales effort are reported to management weekly and meetings are held in division headquarters as often as is deemed necessary. Maintenance of aircraft and ground facilities are analysed by engineers and technicians whose reports examine every detail of the department functions.

These are but a few of the tools available to the management of an airfreight line which is operating efficiently and profitably. The tools, without proper application, are useless and require the attention of management to the last detail.

Importance of Communications

Some of the more concrete items which contribute to the successful operation of an airfreight line are set up in individual departments. One of these, and of highest value, is the *system of communication.* It is very definitely the nervous system of the airline, and without it the line could not function. In the present-day airfreight set-up, teletype on a national scale is most widely used. A leased line connecting the general office with all outlying field stations operates twenty-four hours a day and carries all information necessary to mould a far-flung organization into an efficient whole. Personnel trained in teletype operation are the backbone of this communication system. Every message must be important, otherwise it is sent by company air-mail (Comail). The necessity of limiting the use of these lines to high-priority messages is borne out by the fact that instead of the usual 60 words per minute sending speed, this system has been increased to 75 words per minute.

Customer Service

Another need in the operation of a profitable airfreight line is *customer service*,

Unloading a ten-ton tie-rod for the Aluminium Company of America from one of Slick Airways' new Douglas DC-6A airfreighters at Burbank, Calif. This is the heaviest single piece of industrial equipment ever flown by commercial air carrier.

which management calls the "Service Desk." "Service Desks" are included in the physical and personnel set-up of all stations on the system. Its sole function is to present in a courteous, efficient and prompt manner any and all information pertaining to a customer's shipment, a prospective shipment, pick-up and delivery service.

The following examples are typical in a day's work of the girl who attends the "Service Desk":

Desk : "Good morning, Slick Airways Service Desk."

Customer : "This is Mr. Blank, Traffic Manager at Private Motors Corp. I want to ship 5430 pounds of automotive parts from Detroit to Los Angeles. It consists of 10 packages of bumpers, each weighing 543 pounds. They are 5 1/2 feet long, 28 inches high and 32 inches wide. Can you handle them tonight?"

Desk : "Yes, Sir. They will go out tonight on Flight 112 which departs from Detroit at ten o'clock. They will arrive at Burbank, Calif., Slick Airways freight station at 8 : 43 in the morning. This is over the 5,000 pound breaking point in the tariff and so the rate will be $14.20 per hundred pounds or $756.80. Do you want pick-up and delivery ?"

Customer : "No. We will deliver them to you at the airport. What is the time that they will have to be out there ?"

Desk : "Our closing time for pick-up is 3:00 p.m., but as you are going to send the shipment out they should be here by seven. Will you have the shipment picked up at the airport in Burbank, Sir ?"

Customer : "No, we will want it delivered to our west coast plant."

Desk : "All right, Sir. We will deliver it immediately upon it's arrival and the cost will be 33 c. per hundredweight."

Customer : "That is fine. The shipment will be on your dock at 7.00."

Desk : "Thank you very much for calling Slick Airways, Sir. The shipment will be in your plant tomorrow morning. Goodbye."

Or... At San Francisco:

Desk : "Good afternoon, Slick Airways Service Desk."

Customer : "This is the Pacific Coast and Western Flower Growers, Inc. We had a shipment of flowers to Chicago from here last night and they have not arrived at the specified time. Where are they ?"

Desk : "Will you hold the line a minute, please ?... Thank you for waiting. Your shipment left San Francisco on Flight 111 at 9.00 p.m. last night and was due to arrive Chicago at 9.52 this morning. Due to flood conditions at Kansas City we were not able to use that point as a gas stop and have had to fly to Dallas, Texas. That flight is out of Dallas now and is due in Chicago at 1:00 p.m. We are sorry that this condition exists but the change was necessary in order to keep emergency freight moving."

Customer : "Will the flowers be delivered this afternoon ?"

Air cargo includes everything. Note the large fore and aft doors of the DC-6A, which permit simultaneous loading and unloading of cargo.

Desk : "Yes, Sir. We have a truck waiting at the airport in Chicago for them now and they will go out immediately upon their arrival."

Customer : "All right."

Desk : "Thank you for calling, Sir. Goodbye."

The manner in which the Service Desk performs is a prime factor in maintaining good customer relations and in the securing of future airfreight customers.

These are a few of the many phases of airfreight which go into making up a successful line. We must serve our customers and at the same time build toward the addition of new customers.

New Sources of Cargo

Future cargo for airfreighters will not necessarily consist of products diverted from other forms of transportation. Much of its future business will be derived from completely new sources, at present untapped. Undoubtedly we will divert some business from present forms of surface transportation, but history shows that as new forms of transportation assume importance they infrequently replace older methods.

For example, in this country the motor carrier industry has expanded substantially, but not at the expense of rail traffic, since the total rail traffic also continued to grow during the growth period of the motor carriers. Older forms of transport may continue to progress, along with the growth of our total economy, in spite of the development of new transport forms, of which airfreight is the newest. The end result is an increase in the total amount of transport available.

As a result of airfreight, the San Franciso flower industry has increased its fresh-cut flower shipments to New York from ten million dollars to fifty million dollars in the past five years. Similar results have been achieved in the Los Angeles area and in Texas with perishable goods. Automotive parts from Detroit, clothing from New York, styles from the West Coast, radio and electronics from the Boston area, elephants, iron lungs, and high-priced racing cars are all in the scheme of airfreight.

Slick Airways last month carried a ten-ton tie-rod by air from Philadelphia, Pa., to Los Angeles, California. This was the largest and heaviest single piece of equipment ever flown by commercial air carrier. But our routine airfreight business is composed of quite routine items.

We are planning and making every effort to gear ourselves to the present requirements of shippers and to prepare for the impressive volume of untapped freight potential we know to exist. In this planning we are devoting an important section to the demands of the military. Naturally our entire organization is available to the military at any time, to supply airlift assistance or any other aid, wherever it may be required.

Our Air Force is constantly expanding and new equipment is becoming increasingly available to it, but the airfreight fleets of the scheduled freight lines stand ready to provide both men and equipment which can become available at a moment's notice. Because of this quick convertibility we are important factors in the defence planning of our nation.

Pre-historic man could look upon us today and give us a "Well done" on the continuance of the job that he started: that is, transportation.

A Slick DC-6A air freighter lands at Burbank, Cal., after a nine-hour scheduled coast-to-coast flight.

Cargo Aircraft of Today

According to the American transport agencies, civil air freight in the United States increased by 350% between 1946 and 1950. And Hall L. Hibbard, Technical Director of Lockheed Aircraft Corp., recently forecast that within a few years freight traffic would have surpassed passenger traffic. This prophecy may sound far-fetched, but it is seen to be less unreasonable when the rapidly growing quantities of air freight handled by both scheduled and non-scheduled air transport companies are examined.

However, the question arises of whether air transport today has the equipment to cope with such a development. Although the air forces of the majority of the bigger countries have sizeable fleets of pure transports at their disposal, civilian air freight operators as a rule have to make do with converted passenger aircraft or obsolescent military transports that have been sold off as Army surplus equipment. None of these, however, can meet the demands of modern air cargo transport as regards load capacity and simplicity of maintenance. Freighters do not normally need to be fast, but must be able to carry the maximum possible useful load at minimum cost, *i.e.* the ton-mile cost must be as low as possible. They will therefore have a large wing area (medium wing loading) and a large freight compartment, and greatest stress will be laid on simple, cheap maintenance (efficient engines, low landing speed, fixed undercarriage, etc.).

The growing turnover of their cargo departments has led a number of air transport companies to look around for suitable new cargo aircraft. The choice is limited. However, there are a few efficient models among present-day civilian transports. For example the British twin-engined Bristol 170 "Freighter" is in use throughout the world on a large variety of tasks. France is to make both the promising four-engined Bréguet "Deux Ponts" and the twin-engined Nord "Noratlas" (originally designed for military use) available for civilian air cargo transport. A substantial number of Douglas DC-6A "Liftmasters" is under construction, and Lockheed recently announced a freighter version of the "Super Constellation."—Finally, it is also possible to adapt the military transport—Fairchild C-119 "Packet" (two engines), Boeing C-97 "Stratofreighter" (four engines), Douglas C-124 "Globemaster II" (four engines) and others —for civilian use.

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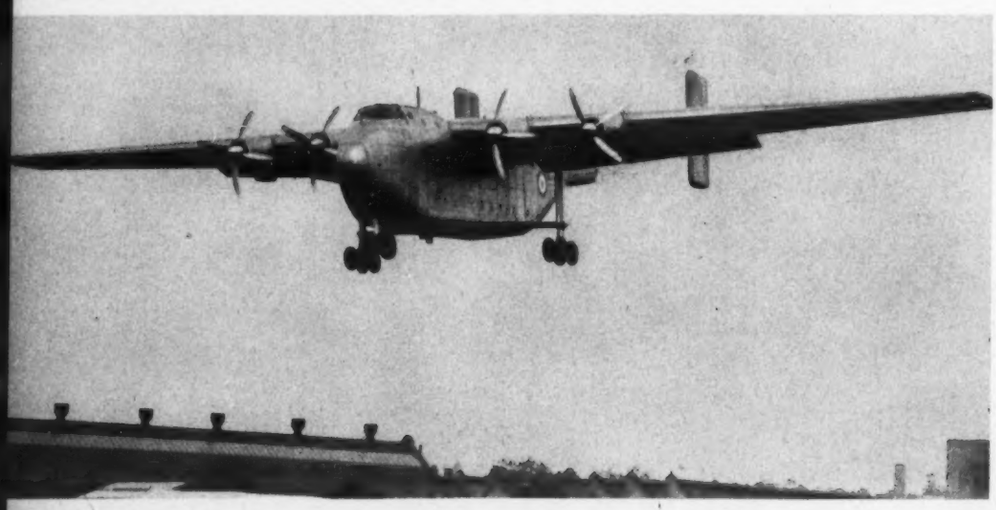
Bristol 170 "Freighter" (Great Britain)

Twin-engined high-wing monoplane developed as civil or military freighter, with fixed tail wheel undercarriage and large loading doors in the nose. The latest version ("Freighter" Mark 31) is fitted with 2020 h.p. Bristol "Hercules 734" engines and can carry a maximum load of 14,429 lbs. freight (or 48 passengers).—Span 108 ft., wing area 1,487 sq.ft., gross weight 42,000 lbs., cruising speed 166 m.p.h., range in cruising flight 850 miles with 10,000 lbs. load.

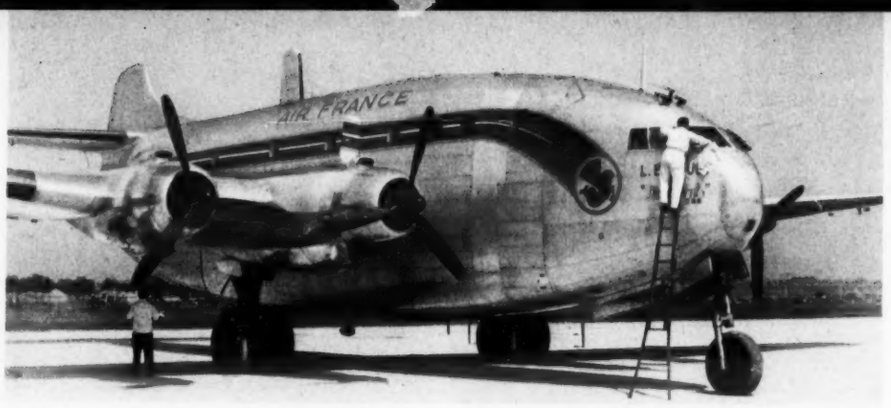


Blackburn & General Aircraft "Universal Freighter" (Great Britain)

Four-engined giant freighter for civilian and military use, with doors in rear of the fuselage. So far only the prototype has flown; work on a second prototype was recently suspended, at any rate temporarily. In spite of its size the "Universal Freighter" can be used to and from relatively small airfields. Its outstanding take-off and landing qualities have been proved time and again: fitted with four 2000 h.p. Bristol "Hercules 761" engines, the fully-loaded freighter takes off in 585 yds., its take-off distance to clear 50 ft. is 1000 yds. and its landing run (reversible-pitch propellers) 375 yds.—Span 162 ft., wing area 2,916 sq.ft., gross weight 103,000 lbs., maximum useful load 30,200 lbs., cruising speed 175 m.p.h., range in cruising flight 1000 miles with 9 tons load. —A *Mark 2* version with 2940 h.p. Bristol "Hercules 171" engines, to have a maximum load of approx. 41,500 lbs. and a gross weight of 127,000 lbs., is in the design stage.

Bréguet 761 and 763 "Deux Ponts" (France)

One prototype and three pre-production models of this four-engined mid-wing monoplane with double-decker fuselage, retractable nose wheel undercarriage and rear loading doors, bear the designation *Bréguet 761* (SNECMA 14 R engines of 1580 h.p. in the prototype; Pratt & Whitney R-2800 B-31 "Double Wasp" of 2000 h.p. each in the pre-production models). The prototype has meanwhile been converted into an anti-submarine patrol aircraft and tested by the French Naval Air Service; the three pre-production models are to be supplied to private companies (*e.g.* Air Algérie) and operated at a gross weight of 99,200 lbs. A main production series of 12 "Deux Ponts" (with 2400 h.p. Pratt & Whitney R-2800 CA-18 "Double Wasp" engines) is under construction for Air France under the designation



Bréguet 763. The first aircraft of the series have been completed; the fifth Bréguet 763 recently started flight tests.—Span 140 ft. 11½ in., wing area 1,195.6 sq.ft., gross weight 106,000 lbs., cruising speed 217 m.p.h., range approx. 620 miles with maximum load of 33,070 lbs., maximum range 2,350 miles.

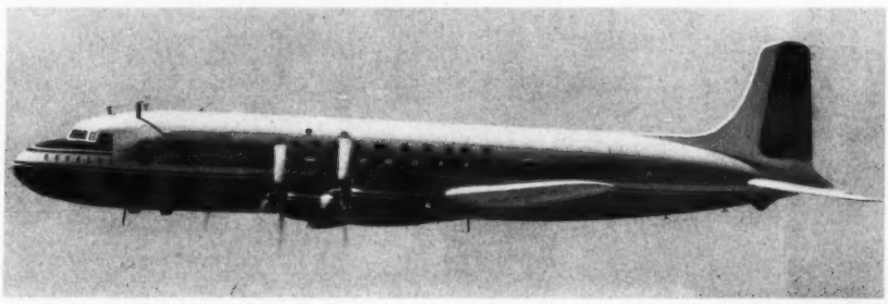
Nord 2501 "Noratlas" (France)

This twin-engined high-wing monoplane designed for troop transport and as a military freighter (loading doors in the rear) is in quantity production for the French Air Force. The original order was for 177 "Noratlas." Subsequently air transport companies also became interested in this aircraft type, and the SNCA du Nord decided to build a smaller number of civilian Nord 2501s, alongside the military version. It is hoped that the first civilian "Noratlas" will be ready for testing early in 1953. Although equipped primarily for the carriage of freight, the civil version is to be suitable for conversion at low expense for second-class passenger traffic (42 seats). Both military and civilian version are to have two 2040 h.p. Bristol "Hercules 739" engines.—Span 106 ft. 7½ in., wing area 1083.7 sq.ft., freight capacity 1800 cu.ft., gross weight 42,990 lbs., useful load 11,685 lbs. for a range of 930 miles.

Douglas DC-6A "Liftmaster" (USA)

The DC-6A "Liftmaster" freighter derived from the Douglas DC-6 passenger aircraft is for both civilian and military use. Designed in particular for the U.S. Navy, the DC-6A will be taken into service under the designation of R6D-1. The Navy has also recently ordered a turboprop-powered version.

The "Liftmaster" has the same wing unit, tail unit and undercarriage as the original DC-6, but has a 5-ft. longer fuselage. It is the same fuselage as is used in the DC-6B (passenger version of the DC-6A). Its pressurized freight compartment is reached by two doors in the side of the fuselage, one fore and the other aft of the wing roots. The four Pratt & Whitney R-2800 CB-16 (or CB-17) engines in the "Liftmaster" each give a take-off output of 2400 (or 2500) h.p. with water-methanol injection.— Span



117 ft. 6 in., wing area 1463 sq.ft., freight compartment 5000 cu.ft., gross weight 106,000 lbs., useful load 30,000 lbs. for a range of over 2000 miles, with a crusing speed of approx. 300 m.p.h., maximum range 4540 miles.

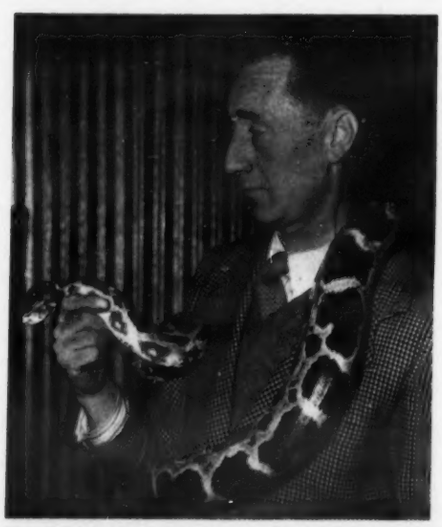
Lockheed L-1049B "Super Constellation" (USA)

Lockheed recently published details of a projected freight version of its four-engined "Super Constellation" airliner. This model, to be known as the L-1049B, is a derivation of the C-121C *(USAF)* and R70-1 (Navy) military versions of the "Super Constellations" already under construction. Lockheed will not build the civilian freighter version unless it first receives orders for it. It is also to be fitted with a pressure cabin and have two loading doors in the side of the fuselage. The power plant provided for comprises four 3250 h.p. Wright R-3350 TC.18 DA-1 "Turbo-Cyclone 18" compound engines.— Span 123 ft., wing area 1,650 sq.ft., freight compartment 5,568 cu.ft., gross weight 130,000 lbs., mean useful load 38,600 lbs. for continental traffic and 36,300 lbs. on Atlantic routes, mean cruising speed 305 to 330 m.p.h., range 3,700 miles with load of 28,500 lbs., maximum range over 4000 miles.—At the same time Lockheed also announced a L-1049D version with propeller turbines. This type, which is described as the "long-range freighter of tomorrow," would have the same gross weight as the L-1049B, but carry a load of 40,918 lbs. in continental traffic and 39,890 lbs. on Atlantic routes. Maximum range would be about 3,500 miles.

Queer Cargos

A pygmy hippopotamus, appropriately christened "Boac," was recently flown from Sierra Leone to Britain by BOAC. It is now at Edinburgh Zoo. The stewardess doesn't seem to be very sure of her friend.

Friesland cattle flew in their namesake, KLM's "Friesland" freighter, a Douglas DC-4.



The blasé-looking individual is Mr. Mason, BOAC's animal man, here shown making friends with a python which arrived at London Airport from Calcutta. (The snake looks frightened).

Proof that flying is a modern achievement. Man's ancestor—in this case a chimpanzee—doesn't seem to be very airminded.

Once upon a time there was a young man who felt his life was in a rut. Every day he handed nicely wrapped parcels of nice woollen underthings over the same counter and in return received various sums of what is euphemistically called "dough" by those who do not know better. The only difference came in the fall when long-legged underthings passed over the counter instead of short ones.

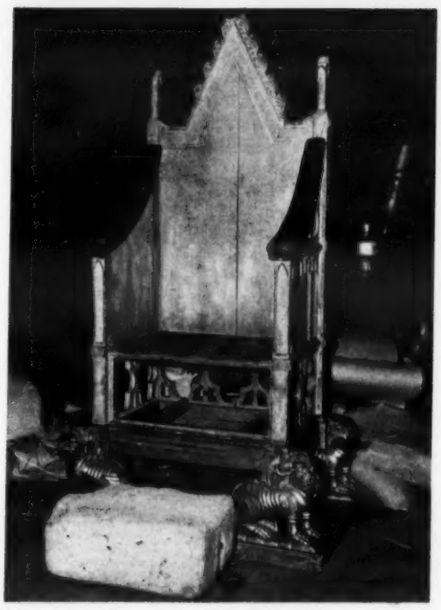
Our friend decided that he needed a change, and luckily he happened to know a blonde working in aviation. To be exact, she was in air cargo, which is an occupation for heroes. How he managed it is a secret, but the fact remains that next time we saw him he was working in the cargo department of an airline. After that he changed jobs frequently, but he stuck to air cargo and merely went from one airline to the next, and his life was dull no longer.

He handled thousands of day-old chicks in very special containers on their way from Scandinavia to Africa and North America by SAS, while, oddly enough, the same commodity also flew from North America to Israel. They seem to want day-old chicks all over the place.

On another occasion our friend took care of five polar bears en route to Idlewild and got scratched in turn when he tried to scratch one behind its ear. He encountered an okapi, several reindeer flying from Finland to the USA, fish of all colours of the spectrum, sucking pigs, cattle, penguins, pygmy hippopotamuses, apes, live geese, crocodiles, snakes, young elephants, silver foxes, and seals. Penguins, he discovered, are happiest in unheated cargo holds, seals have to be liberally sprinkled with water at regular intervals. Monkeys should be accompanied by a medical certificate stating that they have spent the last two nights preceding shipment under mosquito netting: this will avoid trouble from the veterinary inspectors. Birds very often fly by aeroplane —a few months ago His Highness the Amir of Bahawarbur, who is Patron of the London Zoo, shipped four cages of birds via BOAC to London. The birds included Chikores, black partridges, sand grouse, doves, kyenas, bulbuls, parrots and even—sparrows.

Animal shipments have become routine air freight and the airlines take them in their stride. KLM has produced a "Manual for the Carriage of Live Animals" which prescribes the appropriate human behaviour in every beastly emergency. Incidentally, KLM reminds us that the first living creatures to travel by air were not human beings but animals: when the Montgolfier Brothers constructed their hot-air balloon in 1783, people thought it would be wiser and safer to let some livestock have the privilege of making the first ascent. A duck, a sheep and a cock thus took off aboard the car of the balloon. Presently a large tear appeared in the paper envelope of the balloon, with the result that it returned to

Exotic fish from Ecuador to England.

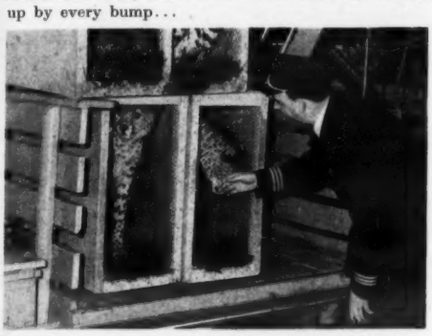


An exact replica of the Coronation Chair and Stone travelled from Montreal to London by BOAC.

Changed days for a penguin—from the barren ice wastes of the South Pole to a modern airliner.

Even birds fly.—From South Africa two Cranes come to Copenhagen Zoo by SAS.

KLM once carried a consignment of wax fashion models aboard a "Convair-Liner." On another, rough night between London and Amsterdam a mysterious screeching and howling arose from the cargo compartment at frequent intervals. It was caused by a large load of mechanical dolls, whose sound mechanism was started up by every bump...



Four Jaguars travel to New York's Zoo by SAS.

Baby elephants for a Swedish circus.

Dried fish flies from Scandinavia to Italy.

earth rather abruptly. The duck was nowhere to be found—probably it thought it wiser to continue flight under its own power—while the cock broke its neck. The sheep, however, casually stalked around nibbling at the grass here and there.

Apart from feathered and furry friends, the airlines carry around a lot of stuff which fits under the heading, "Queer Cargo." BOAC, for example, recently hauled a 600-lb. replica of the Coronation Chair and the Stone of Scone—the original of the latter caused a sensation a few months ago when it was stolen from Westminster Abbey by Scottish Nationalists—to London from Montreal, where it had been since 1937.

Several weeks ago our friend, then working for BOAC, handled a cannon ball being shipped from London to the USA in connection with the gathering of the American MacRae Clan in New York. This cannon ball had been fired by one of the Hanoverian ships "Worcester" or "Enterprise" at Donan Castle, Kintail, in the Jacobite campaign of 1719 and was sent to the American Clan by Captain Duncan MacRae together with a silver plate engraving giving its history.

One day our pal was asked to sprinkle young pineapple plants with lukewarm water. They came from San Francisco and were being carried to the Near East by SAS, and as the shippers wanted to save money on weight, they dispatched the plants directly after "birth," so to speak, and they had to be tended like new-born babies.

Some countries frown upon arms of any description passing their borders, and so our friend routed several shipments of sporting guns the wrong way three-quarters around the globe in order to prevent them from being stopped anywhere but their destination.

The fez is known as the traditional headgear of the Near and Middle East, but it seems that the article is manufactured in Central Europe—at any rate, there is a steady aerial flow of fezzes (?) from those parts to Egypt.

Flowers belong to the most usual types of air cargo. But here is a flower story which certainly is out of the ordinary: a shy young man came to SAS in Stockholm one day to find out whether the captain of an airliner would take a solitary orchid, which he had painstakingly and lovingly grown in his own hothouse, to his fiancée in Australia. The captain faithfully nursed the delicate growth all the way to a small Australian airport, where—before the aircraft captain could protest—a customs officer threw it into the incinerator, afraid of some dangerous and imaginary plant disease...

Paralleling the perambulation of Burnham Forest to Dunsinane, 200,000 saplings were recently carried from Norway to Iceland as part of an afforestation scheme. Apropos wood, a Finnish firm got an urgent request from an American company some months ago, and as a result SAS carried 650 lbs. of toilet seats across the Atlantic.

Queer cargos all—but they form only a minor percentage of the goods which are hauled day by day over the air lanes of the world. Meanwhile, the friend we mentioned earlier in this story is now again handing underclothes across the counter, short ones in summer, long ones in fall. The other day he confided that a year with air cargo had given him enough variety to last him a lifetime.

Which, of course, is as it should be.

Two jumping frogs from South America to Oslo.

Lion cubs being weighed by BOAC stewardess before going aboard the aircraft for Montreal.

Three out of the five young polar bears which were caught at Spitzbergen were sent by ship to Tromsö, flew from there to Oslo by SAS, travelled by ship to Copenhagen and continued by air to New York, where they arrived last August.

NO airfreight. SAS draws the line at giraffes.

Terminals for Air Cargo

Fig. 1: Scale model of the "open Vee" air terminal plan worked out by Lockheed engineers. Cargo trucks drive up the ramp (left) to loading dock level.

The Terminal—Stepchild of Air Cargo

Unloading coal in New York's Grand Central railroad depot or even in the passenger station of a relatively small town would be inconceivable today. Rail freight is handled at separate freight yards with specialized equipment. In shipping the situation is somewhat similar: nobody would expect a Norwegian tramp steamer to unload its cargo at the pier reserved for the "Queen Mary." Air cargo, on the other hand, still does not enjoy such privileges. True, individual attempts have been made in some cities to establish special air cargo terminals —Paris air cargo is ultimately to be handled at Le Bourget, air freight to and from London at Croydon or Bovingdon, and New York air cargo at Newark Airport. As yet, however, the greater part of air cargo is still handled at the Orly, London Airport and Idlewild passenger terminals.

It is quite likely that but for the lack of suitable air freight terminal facilities air cargo would have grown even more phenomenally than it has actually done, and it is a certainty that the continued absence of efficient ground handling and loading equipment will retard further development of the vast unexploited air freight potential.

Thus, the importance of providing well-planned and equipped cargo air terminal facilities cannot be stressed too strongly. Fortunately, recognition of air cargo handling problems has been industry-wide in the past two years, both among aircraft manufacturers and commercial operators. As often is the case in such matters, military emergencies have suddenly highlighted the necessity for adequate facilities—namely, the Berlin airlift and the Korean war. Commercial air cargo terminals would have been of inestimable value to the military services, since they would have permitted higher utilization and quicker turn-around times of America's dangerously limited military airlift fleet.

Handling Facilities help Cargo Growth

L. R. "Mike" Hackney, air cargo sales engineer of Lockheed Aircraft Corporation, has long been one of the most vigorous advocates of suitable air cargo terminals as a means of boosting the growth of air freight. In a lecture on "Planning the Air Freight Terminal"* before the American Society of Mechanical Engineers at the end of last year, he pointed out that in many instances the cost of handling air freight from the consignor into the cargo aircraft and from the latter to the consignee *approaches the actual expense of the air haul!* This condition is also true concerning the time element. While it is recognized that one of the principal advantages of air freight is speed, it is not uncommon to have the time during which the freight is on the ground in pick-up and delivery, waybilling and manifesting, loading and unloading exceed the time the freight is in the air. This unfortunate situation *excludes a large segment of air freight traffic of the so-called short haul potential* (500 to 750 miles) which should be enjoyed by the air transport industry. Although a sizable air freight tonnage is now being carried on the short haul, it is a small percentage of the available potential which can be exploited if a shipper's freight is handled in the proper ratio of ground-time to in-the-air time.

In the USA—as well as in Europe—several important organizations are devoting

*Cf. also: "Air Cargo Loading on the Level," by L. R. Hackney, "Presenting the Aerocargo Equipment Line," Lockheed Aircraft Corp.

Fig. 2: Modified Octagon Plan.

Fig. 3: Modified Hexagon Plan.

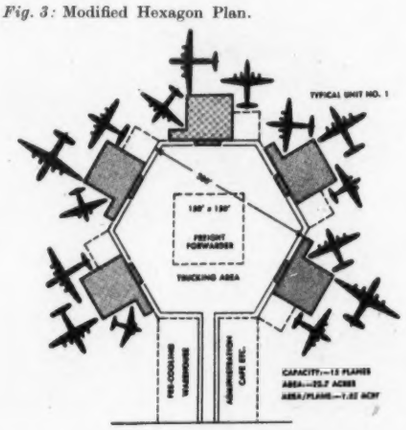


Fig. 4: The "Lockheed Plan" air cargo terminal model is inspected by L. R. Hackney, Lockheed Aircraft air cargo sales engineer, and Gordon Stanton, manager of airport development, Lockheed Air Terminal Inc.

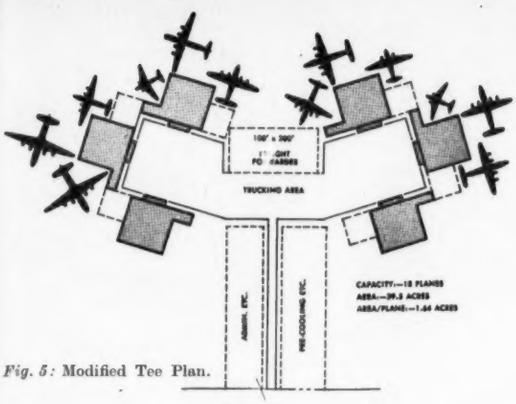


Fig. 5: Modified Tee Plan.

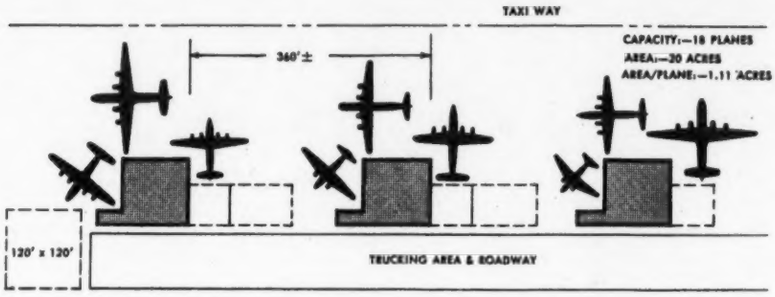


Fig. 6: Straight Line Plan.

intensive study to the problem. One of these is Air Cargo Inc. (ACI), a non-profit corporation which represents a majority of the regular U.S. passenger air carriers in dealing with mutual air cargo problems, and is preparing a basic set of standard requirements to form a guide for air terminal operators. A committee has been established to correlate the recommendations of ACI's members. More than that, ACI has entered the field of practical operations by providing, directly or through contract, pick-up and delivery services, facilities and personnel for mid-town and airport cargo terminals, etc. ACI's efforts are being closely coordinated with those of the U.S. Airport Operators Council.

The various U.S. military services have been conducting their own surveys and studies to improve the material handling of air logistics, and aircraft manufacturers, such as Boeing Airplane, Douglas Aircraft, Lockheed Aircraft and Glenn L. Martin have prepared studies on air cargo handling and terminal facilities.

Terminal Layouts

Among aircraft manufacturers, Lockheed has been one of the most active firms attacking problems presented by air cargo in a practical manner. Its interest in this field stems from its belief that, in order to appraise intelligently cargo transport aircraft design requirements, it had to be thoroughly conversant with all phases of air cargo. Lockheed was well equipped to deal with such problems, since it owns the largest privately owned air terminal in the USA (Lockheed Air Terminal, Burbank, Cal.) and until recently also had a subsidiary manufacturing a number of air cargo handling equipment items (Airquipment Co., which Lockheed sold earlier this year). Together the three branches of the company worked out, under the guidance of Air Cargo Sales Engineer Hackney, plans for an ideal air cargo terminal layout.

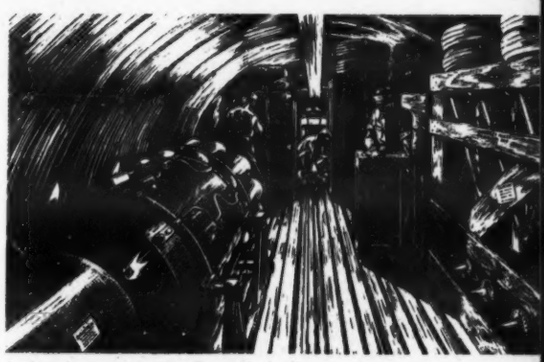
Two prerequisites were constantly considered. First, that the arrangement be as simple as possible. Second, that maximum ramp area and aircraft loading stations be provided for a given warehouse and dock area. Studies of existing air freight docks had revealed that three times as much ramp area is needed as dock and warehouse area. A considerable number of designs was studied, including the following:

Modified Octagon Plan (Fig. 2): Advantages are that it provides an enclosed loading area for pick-up and delivery trucks. This feature is important because aircraft are frequently damaged by pick-up and delivery trucks. Each of the eight individual units could be leased to a separate airline. Furthermore, this design permits ready access between units and requires a minimum acreage. The disadvantage is insufficient loading area which allows only two aircraft to be placed adjacent to each loading dock. Additional aircraft must be stationed at a distance.

Modified Hexagon Plan (Fig. 3): This offers only five units instead of eight. The additional frontage area adjacent to the loading apron and greater spacing of units permits three aircraft to be stationed next to each unit.

Modified Tee Plan (Fig. 5): This uses the same basic units as the modified hexagon plan but provides an additional unit as well as space for a freight forwarding building.

Straight Line Plan (Fig. 6): This permits unlimited addition of units provided the space is available.



Artists impression of "Constellation" cargo transport interior with push-or-pull conveyor in foreground.

Lockheed Plan (Fig. 1, 4, 7): After studying the plans listed above, Lockheed engineers arrived at the conclusion that an open Vee arrangement consisting of two rectangular

Fig. 7: Lockheed Plan.

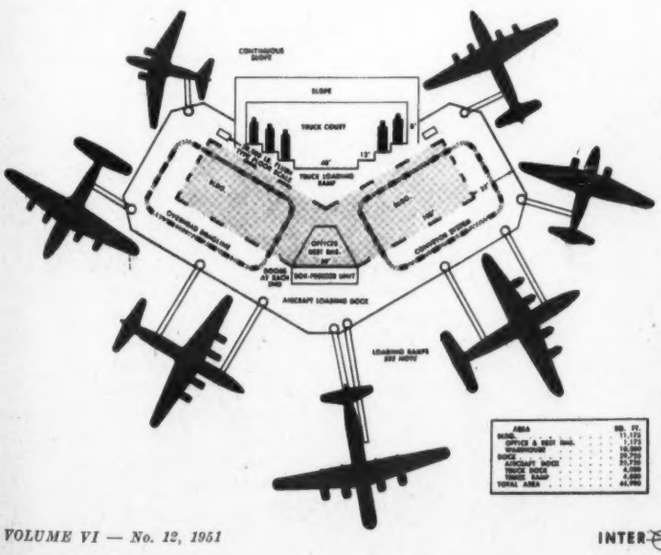


Fig. 8: Mechanical push-or-pull conveyor in door of "Constellation" L-1049B cargo transport mock-up.

Fig. 10: "Aerolift" portable elevator.

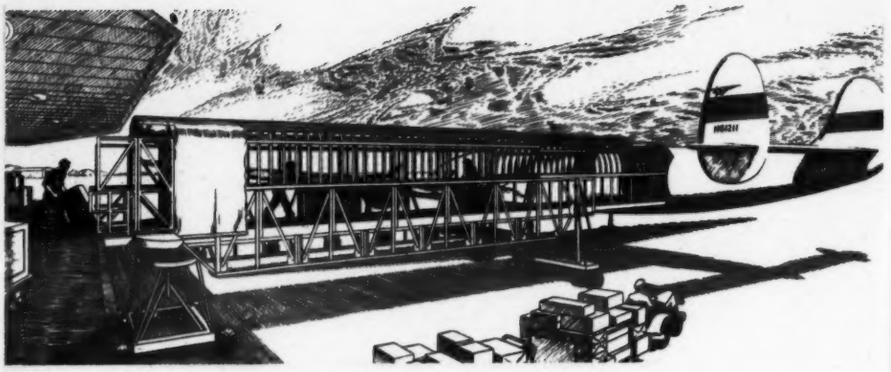


Fig. 12: "Aerobridge" portable self-powered cargo loading gangplank.

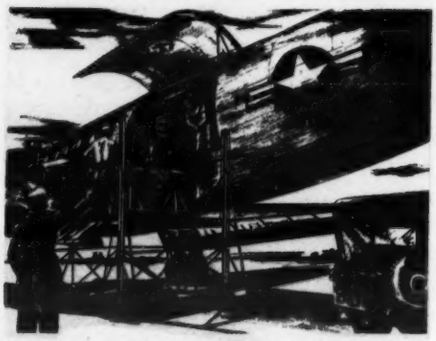


Fig. 11: "Aerolift" cargo elevator in intermediate position.

structures was the most efficient configuration. The Lockheed plan still adheres to the circular grouping principle but shows considerable deviation in other respects. Each of the two buildings is a 50 ft. by 100 ft. structure and provides 5,000 sq.ft. of enclosed warehouse area plus necessary office space. Each wing can handle a maximum of four cargo transports simultaneously. The floor level of the terminal will be close to the height of the floor level of commercial cargo aircraft in operation today (and in the immediate future), in other words, 8 ft. 4 ins. above the ground. This height permits nearly level loading of the Douglas DC-6A and DC-4, Lockheed "Constellation" and Curtiss C-46 "Commando."

Handling Equipment

For the actual handling of air cargo, the Lockheed group of companies have designed a considerable range of special equipment. Two of the most interesting items are not intended for the air cargo terminal of the future but for existing facilities, and one of them forms an integral part of Lockheed's new L-1049B "Super-Constellation" cargo transport. This consists of a *mechanical push-or-pull conveyor* in the floor of the aircraft (Figs. 8 and 9), operated by an electrically driven endless chain submerged in the floor. If heavy freight is to be moved in the cargo hold, a rope is slung around the freight item and affixed to the conveyor hook, and the chain does the rest.

The second is an electrically or hydraulically operated portable elevator, the "*Aerolift*" (Figs. 10 and 11), which quickly raises up to 10,000 lbs. of cargo from ground level

Fig. 13: "Aerocart" used for hand push operations.

Fig. 14: "Aerocarts" used as a tractor train.

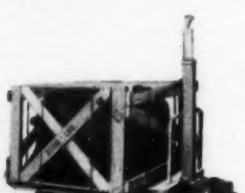


Fig. 15: "Aerocart" with telescoping mast and conveyor hook for use with overhead trolley conveyor system.

Fig. 16: "Aerogarmentrack."

Fig. 17: "Aerocooler."

to the height of an airplane cargo door. It can be disassembled and carried on the aircraft. The "Aerolift" is a variation of another idea, namely, of the cargo elevator built into the aircraft. The Douglas C-74 "Globemaster" giant cargo transport features such an installation.

One piece of equipment designed for use at modern air terminals is the "*Aerobridge*" (Fig. 12), a portable self-powered gangplank which bridges the area between the aircraft's cargo door and a freight dock or terminal building. It is adjustable both in length between 76 ft. and 89 ft. and in height (at the aircraft end) between 4 ft. and 10 ft. Width is 8 ft. It can carry a total load of 23,400 lbs.

In addition, the concern has developed a set of small vehicles for the ground handling of air cargo at existing and future cargo terminals and also at passenger terminals. These are the "*Aerocart*" which can be used for hand push operation (Fig. 13) or for tractor train use (Fig. 14), or, provided with a retractable mast, with overhead trolley conveyors (Fig. 15). Another is the "*Aerogarmentrack*" (Fig. 16) which serves to transport un-packed clothing from and to the aircraft.

Finally, the Lockheed air cargo equipment line includes the "*Aerocooler*" (Fig. 17), which is a walk-in storage box for the protection of perishables while awaiting airborne shipment. It uses wet ice as a refrigerant to maintain high humidity in the air and can be quickly assembled and disassembled. In winter it can be converted into a warm holding box by installing any type of heater in the ice bunker compartment.

*

This enumeration of air cargo terminal plans and equipment items represents only a small part of the effort which is being devoted by the aircraft manufacturing and airline industries to the problem of enabling air cargo to reach its full scope of expansion. Some types of equipment are already in wide use all over the world *(e.g.*, the fork-lift!), and others are being developed. While some of these activities are still in an early phase and have not yet produced concrete results, they will ultimately help air cargo to play the same important role in air transportation as freight plays in surface transport and shipping.

Air Cargo

But it Moves for all that!

Cointrin airport, Geneva. Two airliners wait for their loads.

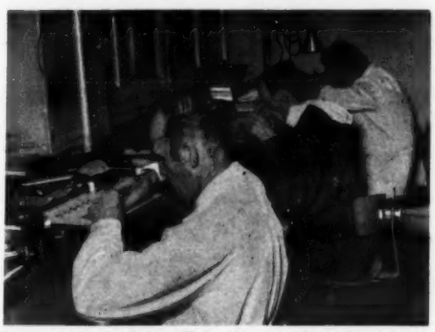
The scene is familiar: a man pushing a heavily loaded cart across the apron towards the waiting aircraft, sturdy hands picking up case after case, heaving them into the cargo hatch. Engines roar, and another load of airborne goods is on the way to its destination. A routine event, repeated thousands of times every day all over the world.

We wondered vaguely what leads up to the final, slow progress of the cart towards the aeroplane and decided to find out by following a shipment of air cargo from the manufacturer to the aircraft. The people at Geneva airport confirmed what we had known for a long time, namely, that a major portion of air cargo shipped from there consists of products of the Swiss watchmaking industry. Accordingly we got into touch with one of Switzerland's oldest watchmaking companies, *Vacheron & Constantin*, who have a factory making high-precision luxury and ornamental watches right in Geneva, as well as a very large plant at Le Sentier, in the Jura mountains, where the *Jaeger-LeCoultre* watches are made. Yes, they said, we could come along and inspect their assembly and packing departments any time we liked.

We started in one of the finishing room where a number of watchmakers, seated on short-legged stools, magnifying glass tightly clamped in their eyes, were assembling the watches. From the finishing room the watch movements go to the testing department, where they are carefully checked on the bench; from there to the final assembly department, where skilled fingers place them in their cases. There follow more tests and checks, and when finally found sound in wind and limb, they are shifted to the company's store rooms, ready for shipment.

Suppose the manufacturer now receives an order for a quantity of watches with the stipulation that they should be despatched by air. Instructions are sent to the store room to issue the desired types and quantities of watches to the invoicing department. If the client is reliable, these watches are considered as good as sold.

But they haven't left the maker's building yet, and they are not liable to leave the invoicing department for the shipping department for anything from three days to more than a week. It is at this juncture that the first phase of the paper war breaks out in all its fury. Its fierceness depends upon the country for which the watches are destined. Take Egypt as one of the "easy" examples. Prior to shipping the goods, the manufacturer must fill in an "export declaration" for the Customs giving all the details of the merchandise, destination, brand, packing, weight, value, etc. Once filled in, this declaration must be sent to the Swiss Horological Chamber of Commerce at La Chaux-de-Fonds for approval. When the declaration is returned, suitably provided with the Chamber's visa, all that is needed is the ordinary commercial invoice.



Some of the load is still in the manufacturing phase. Each of these three watchmakers in one of *Vacheron & Constantin*'s finishing rooms is assembling six watch movements.

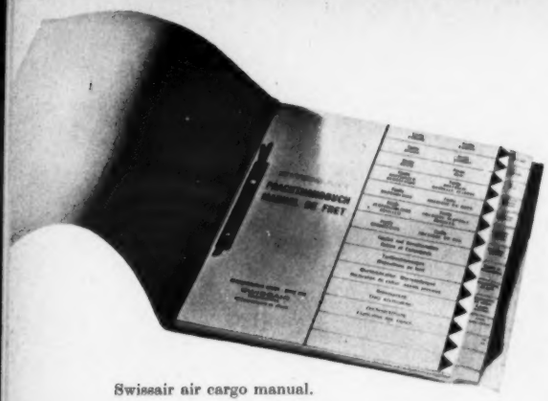
The watches are brought from the store-room to the invoicing department, where the paper war breaks out.

Can the shipment now leave for the packing room? Yes—provided that the Egyptian client has previously filled in an import application, again visaed by the Horological Chamber of Commerce; that he has obtained an import licence from his Government; that he has secured a money-transfer permit from his Finance Ministry; and that he has established a letter of credit in favour of the manufacturer. Presumably the buyer has taken all these steps before sending in his order, so that the total delay amounts to about three days.

More complicated is the cases of Argentina, for example. Upon receipt of an Argentine order, the manufacturer must obtain an authorization from the Swiss National Bank and pays 4 percent of the commercial invoice total into a special fund which serves to compensate for currency exchange losses, etc. He then gets his export permit, again checked and visaed by the Horological Chamber of Commerce. But the Chamber must also stamp its visa on the ordinary commercial invoice. Accompanied by a suitable number of duplicates and triplicates, the invoice and export licence must be taken to the Argentine Consulate which legalizes the lot and issues six Consular Invoices which accompany the shipment. Time required is 8 to 10 days. The buyer, on the other hand, again must be in possession of a

A corner of the shipping room at the watch factory. The heavy cases are for surface shipments, the light cases (centre and top right) and the aluminium box for air cargo consignments.

A shipping clerk packs carefully wrapped alarm clocks in the light plywood case.



Swissair air cargo manual.

money transfer permit and an import licence and has to establish a letter of credit.

If the manufacturer is not too discouraged by now and intends to go through with the deal, he passes the watches on to the shipping department. They are carefully wrapped, each watch by itself, and placed in cases. The cases are marked, labelled and weighed. Here one of the most obvious advantages of air freight becomes apparent: piled up

An airline's air cargo department at Cointrin airport. The picture shows part of the Swissair cargo office.

are large, thick-walled packing cases covered with stencilled numbers and letters—these are for shipments that go by rail and boat. Smaller cases consisting of thin plywood boards, in this instance packed with alarm clocks, are intended for despatch as air cargo. Finally, relatively small batches of watches are packed in aluminium tins for transportation by air. For air cargo cheaper packing materials can be employed, which in the case of mass-produced goods can be

An air cargo shipment is weighed for the last time at TWA air cargo terminal at Cointrin airport.

of great importance; another is that pilferage or substitution of goods—common occurrences in long-distance surface transportation —are very rare, partly because air transportation is so fast as to exclude any serious premeditation. One result is lower insurance premiums.

The air cargo shipment is packed and ready to go. The shipper now has two alternatives—either to do the actual shipping himself or hand the consignment over to a forwarding agent. Since this particular

From the airline's city terminal the air cargo arrives by van at the airport.

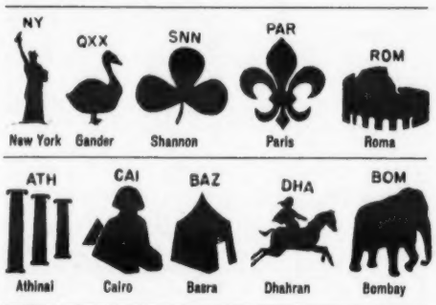
parcel goes to Cairo where no unusual difficulties or formalities are encountered, the manufacturer decides to look after the despatch himself—and enters the second phase of the paper war. He gets out an Air Waybill, an impressive document consisting of a top copy and 10 carbon copies of different colours. He fills in details of the consignee's address and of the consignment itself and takes the lot to the city cargo terminal of the air carrier concerned—in the present case either to Swissair's office

In the Customs hall the TWA employee announces the shipment to the Customs inspector. (Under Swiss regulations it is forbidden to photograph Customs officials—unless a special written authorization is obtained !)

or to that of Trans World Airlines; he chooses TWA, because an aircraft leaves for Cairo the same day. Of the eleven copies of the Air Waybill, four are originals: one is kept by the shipper, one is intended for the consignee, and two are for the carrier; of the seven copies, one is a delivery receipt to be signed by the consignee, one represents a customs import and one an export declaration, one is for the carrier accepting the shipment, two are for any other carriers in

Geneva-Cointrin airport : the cargo terminal wing.

the case of transshipments, and one is kept by the forwarding agent if one is employed. The Air Waybills are sold complete with carbon paper inserted and the whole lot stapled together so that all copies can be typed out in one operation. Even so, eleven copies is a lot. But we gasped when we learned that for shipments to most South American countries 16 copies are needed! Incidentally, if a private person makes the shipment, the airline does all the filling-in of the Air Waybill.



At TWA's city terminal, the consignment is weighed again. The cargo clerk pulls out the tariff and calculates the charges which must be paid. The case of watches going to Cairo weighs 10.7 kg. and pays Swiss francs 5.20 per kg.

Freight rates today are set out in easily handled air cargo manuals, one of which (Swissair's) is visible in the photo. A lot of work has gone into the elaboration of the cargo tariffs, and a great deal of credit in this respect goes to the International Air Transport Association, under whose guidance mutual tariff problems were thrashed out jointly by the IATA member airlines. Progressive standardization of IATA tariffs and carrying conditions aims at making them uniformly valid in all parts of the world. Swissair's freight manual was compiled to satisfy a staff demand for a simple means of calculating cargo charges and providing information to clients. It is divided according to groups of countries and enables cargo rates to be determined rapidly for all destinations, no matter which airline flies the load. It also lists carrying conditions, transit and handling charges and special tariffs.

At the city terminal the watches are placed in the cargo room. Presently they are loaded on the truck and taken out to the airport. There they are weighed once more to enable the airline people to engage in the third phase of the paper war, namely, to make

The employee now moves to the Customs office to present the export declaration and obtain export clearance for his shipment.

out the "cargo manifest." This impressive document lists exact details of all the cargo which the aircraft carries from any one station to any other along the route. For example, if shipments from Geneva are intended for Shannon, Gander and New York, three manifests are needed. What is more, large quantities of copies of each

TWA's air cargo enclosure at Cointrin. The man with the cart is about to start on his trip across the apron to the aircraft.

manifest must be prepared. A manifest listing shipments from Geneva to New York, for instance, needs no less than 48 copies, of which the air carrier keeps 9 for his files, 8 are handed to the airport authorities at Shannon, 8 to those at Gander, 2 to the customs people in New York, 1 to the Public Health authorities, 10 to the forwarding agent in New York; 10 are kept in

Nearby a Swissair "Convair-Liner" is being loaded with mail bags for London. A modern loading aid is in use—a powered endless-belt conveyor.

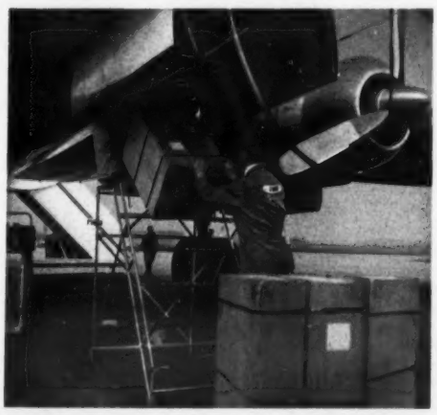
reserve in case other amateurs crop up. If an aircraft carries shipments to several destinations on one route, it has to take along literally hundreds of cargo manifest copies, distributing them as it goes along! Geneva-New York is one of the more complicated cases, of course. Non-stop Geneva-London and Geneva-Paris loads need "only" about 12 copies of the manifest.

Duly manifested and weighed, our case of watches is now ready to affront the Customs. Some airlines, such as TWA,

Part of the export air cargo store-room, where the cleared consignments await loading. The good-looking young man is Henri Dütsch, Swissair's air cargo operations chief at Cointrin Airport.

stamp each consignment with a distinctive sign to enable unloading crews quickly to spot each shipment due at any particular station: the Statue of Liberty for New York, an elephant for Bombay, and so on.

In the Customs room the air cargo employee announces the shipment to the inspector, who takes down its particulars. The employee takes the export declaration to the Customs office to have it cleared, and



Air cargo disappears in the belly of the waiting "Constellation."

the clearing official may ask for the case to be opened and inspected. Watch manufacturers are very careful in their declarations, however, and only about one-half of one percent of all shipments are opened for spot-checking. Once the consignment is cleared, it is sealed and taken to the airline's own air cargo store room to await shipment. It stays under Customs control, and no outsider is allowed near it.

An air cargo store room is a fascinating place. There are piles of small and large boxes and parcels, all numbered and labelled.

We tried to lift up one of them and managed to do so—but only just: it was part of a consignment of gold! At Geneva Swissair looks after the cargo shipments travelling by a large number of airlines, including Air France, BEA and others. TWA takes care of its own and those of Air India International. Pilatus, the Swiss servicing organization, handles shipments for a number of charter operators, such as Braathens SAFE (which carries about 4 tons of watches to Hong Kong every Saturday) and Seaboard and Western.

When the aircraft arrives, the cargo is loaded on to carts, and we meet the familiar sight of an employee pushing the vehicle across the apron to the waiting aircraft... On busy days, of course, the carts are hooked together to form a tractor train.

A roar of the engines, the aircraft turns into the taxiway, trundles to the end of the runway. A minute, Vacheron & Constantin's watches are on their way to Cairo, where they will arrive more safely and quickly than by any other means of transport, in spite of all the handicaps. Meanwhile, the invoicing department of the manufacturers and the air cargo staff of the airline is already engaged in a new paper war, preparing shipments for the next flight to another destination.

Perhaps Galileo Galilei had a visionary idea of the difficulties that were to beset air cargo in a later century when he said: "Eppur si muove"—"But it moves for all that!"

The "Constellation" has turned away from the ground paraphernalia and moves down the taxi strip to the end of the runway. Soon the cargo will be airborne en route to Cairo.

Silver City Airways British base of the cross-Channel operation, Lympne Airport, Kent. The company's six Bristol 170 "Freighters" are lined up.

Air Cargo

Your Car by Air

An Unusual Air Cargo Operation Pays Off

The Ferry is Opened

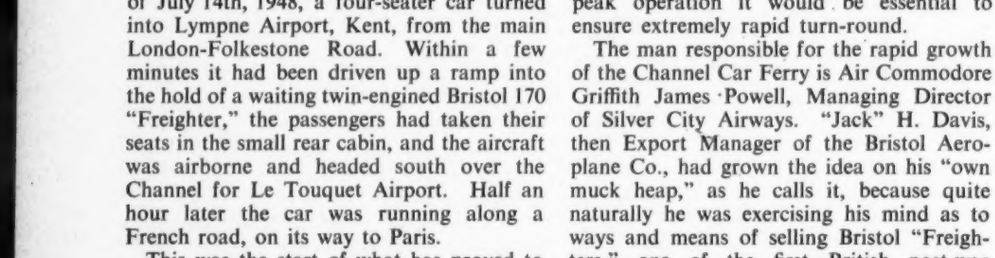
Shortly after 11 o'clock on the morning of July 14th, 1948, a four-seater car turned into Lympne Airport, Kent, from the main London-Folkestone Road. Within a few minutes it had been driven up a ramp into the hold of a waiting twin-engined Bristol 170 "Freighter," the passengers had taken their seats in the small rear cabin, and the aircraft was airborne and headed south over the Channel for Le Touquet Airport. Half an hour later the car was running along a French road, on its way to Paris.

This was the start of what has proved to be one of the most successful civil aviation projects undertaken from scratch in Europe since the end of the war—the Lympne-Le Touquet aerial car ferry operated by Silver City Airways. In those early days, services between the two terminal points were limited. The company had no regular operating licence, which meant that the single aircraft allocated to the job could operate only on a charter basis. The number of cars carried during the first season was low—less than 200. Nevertheless, the experience gained was invaluable. Operation of the aircraft, methods of loading and securing vehicles in the hold were carefully studied, for it was obvious that when the ferry approached peak operation it would be essential to ensure extremely rapid turn-round.

The man responsible for the rapid growth of the Channel Car Ferry is Air Commodore Griffith James Powell, Managing Director of Silver City Airways. "Jack" H. Davis, then Export Manager of the Bristol Aeroplane Co., had grown the idea on his "own muck heap," as he calls it, because quite naturally he was exercising his mind as to ways and means of selling Bristol "Freighters," one of the first British post-war aircraft. For the best part of two years he hawked the project around potential operators and the automobile clubs, but it was only when he contacted "Taffy" Powell that the latter, with his usual spirit of adventure and farsightedness, agreed to be present at a decisive meeting with the Automobile Association and the Royal Automobile Club with whom Jack Davis had previously been in discussion without avail. At that meeting "Taffy" Powell agreed—albeit somewhat with his tongue in his cheek—to give the idea a trial.

A little over a year later the service was in operation. Before the war Powell had been a senior pilot of Imperial Airways and had taken part in the first North Atlantic flying-boat flights operated by Imperial Airways and Pan American Airways. When war broke out he obtained leave of absence to join the Royal Canadian Air Force; he became Senior Air Staff Officer of RAF Ferry Command when the latter was formed in Montreal early in the war, an appointment he retained until the end of hostilities. In that post he was largely responsible for the North and South Atlantic aircraft ferrying operations conducted by the RAF. He re-entered civil aviation at the end of the war and has been Managing Director of Silver City Airways since it was formed in 1946.

The company's "Freighters" are overhauled at Filton, Bristol, during the off-season. The one nearest the camera is getting ready to return to Lympne.



Comfortable and Time-Saving

In the second year of operation, 1949, the ferry got away to an earlier start, re-opening in mid-April with two "Freighters." It resumed as a scheduled service, since the company had meanwhile become an "associate" of the government's British European Airways Corporation and as such was permitted to engage in regular time-table operations.

Motorists in a hurry to get from "Austerity"-saddled England to the Continent were attracted by the speed and comfort offered by the ferry. The flight over the Channel takes only twenty minutes, and with car loading times reduced to a minimum it is possible to be well away on the road from the terminal within an hour after arriving at the departure point. The terminals had been wisely chosen, since they gave the shortest reasonable air bridge: cars are flown only where they cannot be driven, thus making the crossing as cheap as possible.

Air Commodore G. J. Powell, Managing Director of Silver City Airways.

All you do upon arriving at one of the terminals is to present your customs documentation to the officials, and after a brief check your car is whisked away by a Silver City employee and driven under its own power up the ramp into the aircraft. There is no waiting, since no large crowds of motorists queue up at the customs offices—as is the case with the boat ferries. Passengers of the cars are accommodated in a sound-proofed cabin at the rear of the aircraft, and their baggage stays in the cars. The vehicles are firmly shackled at the wheels by means of special quick-release attachments picking up on the floor of the hold. The Bristol "Freighters" in use on the service have been specially modified for their job. By re-positioning the nose-door struts the available cabin length has been increased by more than two feet, which

enables two of even the largest cars to be carried together. Recently Silver City has been holding discussions with the Bristol Aeroplane Co. on the subject of a Type 170 "Freighter" version specially designed for this service, with emphasis on a longer freight compartment and greater passenger capacity.

The car-loading ramps in use by the company deserve special mention, since they are the outcome of three years' experience in handling automotive vehicles. In view of the short 20-minute flying-time involved on each trip, even brief delays can easily result in the loss of a service during the day.

The twenty-foot self-propelled ramp, built by J. Westwood & Co., Ltd., of Millwall, London, is powered by a 2½ h.p. engine. The driver has only one control: by pivoting the steering wheel downwards he opens the throttle and engages the clutch. Raising the wheel closes the throttle, disengages the clutch and applies the brakes. For reversing the wheel is turned right around. Two pairs of double 18-inch unsprung wheels support the rear, a single wheel the front of the ramp for manoeuvring. When the ramp is finally in position at the aircraft it is stabilized by two manually-operated jacks. The ramp's maximum speed is 5 m.p.h. It takes about two minutes to position and be ready for use.

Fares

By the end of July, 1949, the company was operating six flights a day. This increase in traffic was obtained despite the relatively expensive fare required. For a single journey, cars under 14 feet in length were charged £27 and over 14 feet £32—which also covered passengers and luggage. "Off-season" rates of £19 and £25, respectively, were introduced in the autumn of 1950 for the first time. With the introduction of a projected new route next spring, Silver City hopes to put into operation a revised fare structure with lower rates.

One major difficulty in reducing fares is the incredibly high landing charges involved in the operation. Although the flight time is only 20 minutes and a large number of landings are made every day, the Ministry of Civil Aviation charges £6 17*s.*6*d.* for each landing at Lympne—which means that the landing fees represent over 20 percent of the operating costs. During August, 1951, landing fees paid at Lympne alone amounted to about £6,000, representing the entire gross revenue from 250 medium-size cars and 1,000 passengers, equivalent to 125 single trips with a 100-percent load factor!

Passengers take their seats in the soundproofed saloon at the rear of the freight hold.

Optimism Justified

It was the 1950 season which finally disposed of any lingering doubts about the car ferry's future. Permission was given by the Ministry of Civil Aviation for the company to operate the service for another two years under the BEA associate agreement. Additional facilities for passengers and customs officials were built at both terminals, for there was every indication that traffic would be heavy, especially at Easter—which coincided with the opening of the Le Touquet Casino. In all, nearly 4,000 cars and 1,000 motor-cycles and miscellaneous vehicles were flown across the Channel during the year.

Optimistic forecasts based on 1950 results were fully borne out in 1951 which showed a phenomenal growth in traffic—partly due, it is true, to the Festival of Britain. This growth is graphically illustrated in the following table:

	1951 (*end August bookings*)	1950	1949	1948 (*charter*)
Vehicles carried	11,853	4,769	2,700	178
Passengers carried	31,816	15,045	7,900	595
Highest daily round-trips	42	24	6	—

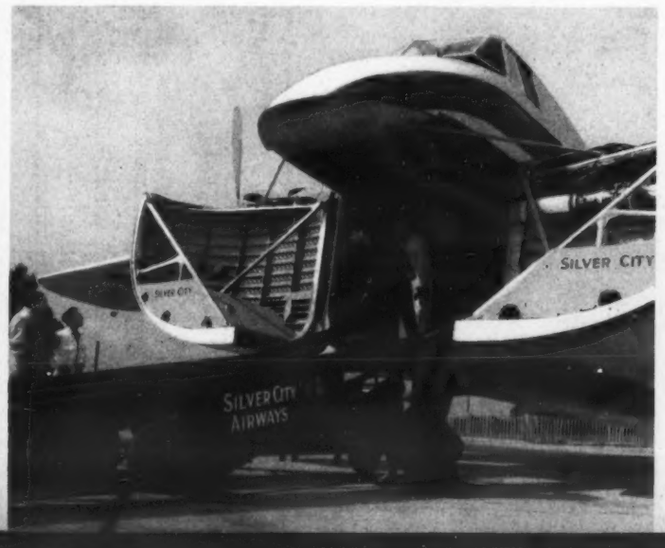
Imposing as this record may be, it has by no means reached the limit of potential expansion. The company has introduced a tariff which will be particularly attractive to small cars and motor cyclists. For the latter, who include a high percentage of enthusiasts who like to start early and cover an enormous daily mileage, Silver City will operate early morning "specials." This year for the first time the ferry goes on to a year-round basis of operation, and it is anticipated that a reasonable volume of traffic will be forthcoming, though naturally not in such numbers as those produced by the summer months. In 1951 six "Freighters" have been employed on the service; Silver City Airways has just taken delivery of a seventh aircraft and expects to increase its fleet still further by the middle of next year—when a new route is planned to be in operation.

Future of Car Ferry

For some time the company has felt—although the Lympne-Le Touquet ferry has by no means reached saturation point—that the introduction of an additional route would lead to new traffic. Accordingly an application was filed with the Ministry of Civil Aviation, and it seems that the application has been, or is about to be, granted. On October 14th a "Freighter" made a proving flight on the projected ferry route between *Southampton and Cherbourg*, carrying "Taffy" Powell, a number of officials, eight passengers, two cars and a motor cycle. In November a regular cargo service is to be opened to gain operational experience, and in spring the new ferry is to be inaugurated. Services are to be timed to meet the arrival of trans-Atlantic liners.

At the present time Silver City Airways sees no limit to the traffic which these services might develop in the next few years. Freed of licensing problems—and if the war clouds stay away from Western Europe—the "automobile air lift" might grow to an extent which would put the Channel Tunnel project very much into the background.

The self-propelled ramp is driven up to the sill of the aircraft's hold, cutting loading and turn-around time to a minimum. The driver is visible between the two wheel guides at the forward end of the ramp.



In addition to passenger car ferrying, Silver City Airways now also delivers British export cars to France. Picture shows a Hillman "Minx" and a "Minx" station wagon being unloaded at Le Touquet.

The Fairchild C-119 "Packet" on loan to the Iron Ore Company of Canada flying over the St. Lawrence River near Sept Isles, Quebec.

Air Cargo

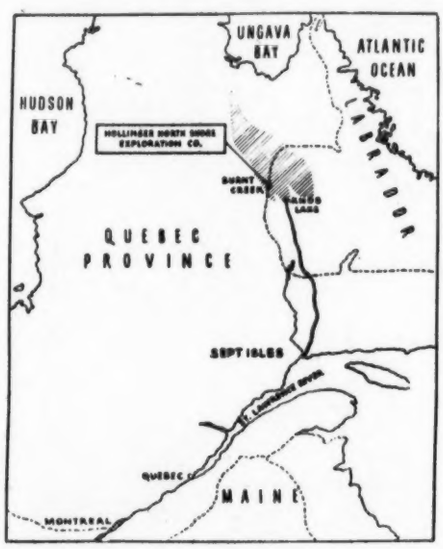
Operation Ungava

Air Cargo Speeds a Development Project

An Indian trapper and a Fairchild C-119 "Packet" cargo aircraft can share a large part of the credit for replenishing the dwindling iron ore supplies needed for the intensive defence effort of the United States and Canada. The trapper because he brought a specimen of rich ore out of the Labrador wilderness; the "Packet" because in the course of two months it air-lifted enough equipment into the barren North to enable a fabulous 15,000,000 tons of ore a year to be mined from 1954 onwards—about a year earlier than would have been possible without its help.

About 15 years ago Matthieu André, the Indian trapper, handed a piece of iron ore to a Canadian geologist, Joseph A. Retty, who spent the succeeding summers exploring the Ungava region near Knob Lake, 320 air miles north of the small, 300-year-old St. Lawrence River port of Sept Isles, Quebec. He found the area littered with high-grade ore. A few years after the first find a Canadian mining company, Hollinger Consolidated Gold Mines, Ltd., became interested in the deposits and formed the Hollinger North Shore Exploration Co., Ltd. Under W. H. Durrell—famous as the builder of the Goose Bay air ferry base and other war-time facilities in Labrador and Newfoundland—a permanent base was established at Knob Lake in 1948, and projects were worked out for a 360-mile railroad linking the field with Sept Isles. In 1949 a group of U.S. steel producers combined with the Hollinger interests to form the Iron Ore Company of Canada (IOC) which will bring the field into production.

And this is where the C-119 "Packet" came in. To prepare the exploitation of the huge ore deposits, IOC gathered a motley fleet of 12 transport aircraft of all types and sizes, including a "Catalina" flying-boat, for the purpose of carrying machinery and equipment to Knob Lake. Soon it became evident that the capacity of these machines was inadequate to haul heavy equipment. IOC therefore got into touch with the U.S. State Department for the loan of an Air Force C-119 "Packet." A bailment contract for the aircraft was signed with the USAF and a 10-man civilian air crew selected from the Fairchild Aircraft Division Flight Test Department—an excellent example of all-round cooperation between commercial and military organizations of two nations in a vital defence project.



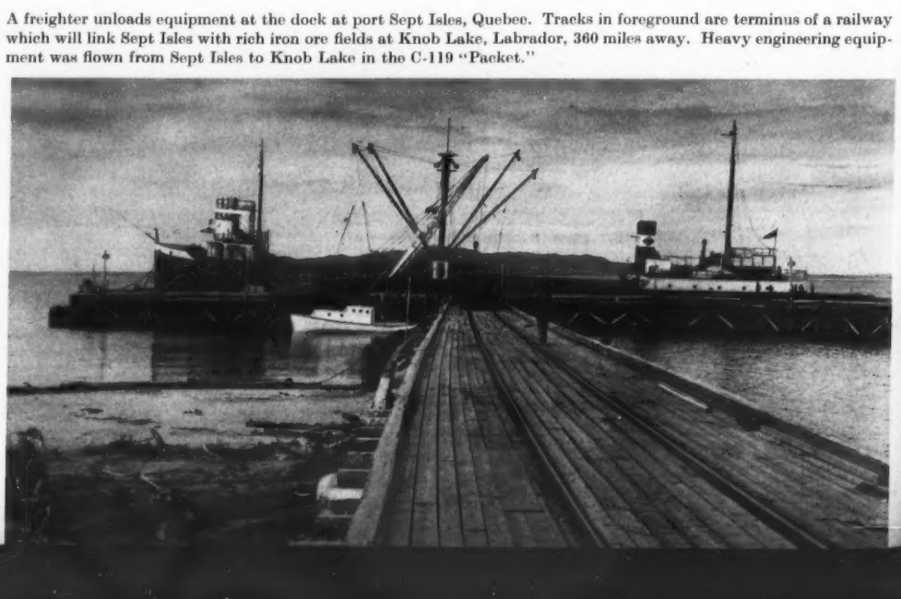
Map of the airlift region. Line connecting Sept Isles and Knob Lake shows route to be taken by railroad now under construction. Rich ore fields are in shaded area.

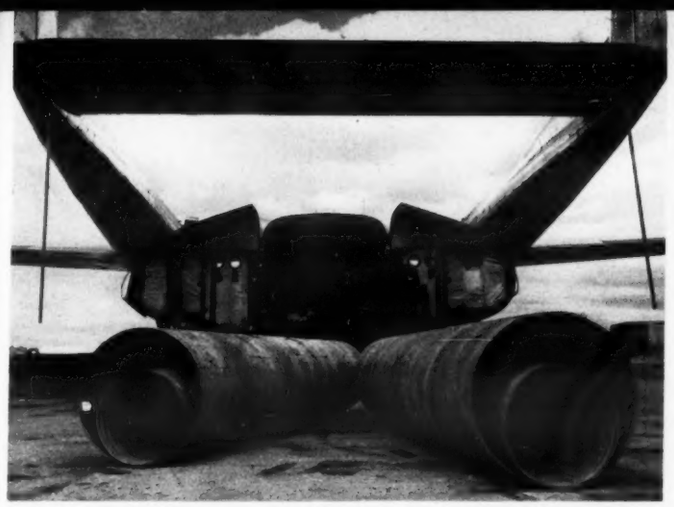
Between May 26th and July 31st 1951 the "Packet" carried caterpillar tractors, power shovels, scrapers, loaders, three-ton and one-ton trucks, compressors, rooters, generators, winches, 25-ft. lengths of culvert pipe, 25-ft. bridge timber and tons of groceries to the mining sites, across a region of sand and rock covered with Canadian spruce and laced with 3,500-ft. mountain ridges. Since the rugged climate permits work in the area only six months every year, the equipment was needed in a hurry to speed building of 150 miles of roads in the development area, the railroad to Sept Isles, dams, highways and camps. Altogether the "Packet" made 135 flights, carrying 2,031,905 lbs. of equipment. A series of 14,000-lb. caterpillar tractors and 15,000-lb. rooters were transported without dismantling; two 3-ton GMC trucks made up one load; 40,300 lb. power shovels were sectionalized to make up loads ranging from 14,000 lbs. to a 20,000 lb. overload.

The result of this intensive effort by a group of rugged men will be the establishment of a mining town housing a population of over 3,000, working the fabulous Ungava iron ore field. The field measures about 30 by 50 miles, and drillings to 700 feet have indicated no end to the supply of the rich ore (60 to 69 percent pure iron). The railroad track, which will lead across every conceivable kind of terrain and pass through several tunnels, is being built from both ends of the line, Sept Isles and Knob Lake, as well as from two big intermediate camps. It will ultimately turn Sept Isles into a major ore port, and work on the piers and docks has already begun. At Sept Isles the ore will be transshipped, first by cargo boat, then again by railroad, to the iron foundries in the USA.

Thirty miles south of Knob Lake a dam is being constructed at Lake Menihek to

A freighter unloads equipment at the dock at port Sept Isles, Quebec. Tracks in foreground are terminus of a railway which will link Sept Isles with rich iron ore fields at Knob Lake, Labrador, 360 miles away. Heavy engineering equipment was flown from Sept Isles to Knob Lake in the C-119 "Packet."





Twenty-five foot lengths of culvert pipe fit easily into the cargo hold of the "Packet." French-Canadians are loading the aircraft.

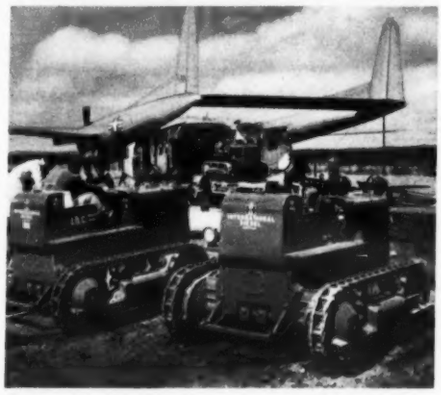
Square-bridge timbers, 16 by 16 inches and 25 feet long, go aboard. They were needed in the construction work going on at Knob Lake as a prelude to mining operations expected to begin in 1954 after completion of the railroad. Canadian spruce trees grow in abundance in the remote region, but they rarely exceed fifteen feet in height or the thickness of a man's wrist at the base.

provide electric power. For this purpose 25,000 sacks of cement were air-freighted by the "Packet" to a special airstrip prepared near the construction camp. The water of the lake will ultimately be used to drive a hydro-electric plant supplying 30,000 h.p. for the operation of the mine and the town. Construction work in the area springs all sorts of unwelcome surprises on the builders. Some of these are due to the weather; one difficulty was to find suitable gravel and sand to mix concrete, since the abundant iron-laden material oxidizes and causes the concrete to decay.

Iron-bearing rock is inspected by members of the "Packet" crew. Picked up off the street of the tiny settlement at Knob Lake, which houses workmen on the giant development project, the pile waits for the day when the railroad is in use.

The ten-man Fairchild crew, headed by Assistant Chief Test Pilot E. R. "Dutch" Gelvin, settled down to their difficult task with a vengeance. They split up into two eight-hour shifts to make the best use of the long daylight hours of the northern summer. In spite of unusual difficulties, they accomplished several flights daily over the 320-mile route, plus several over the 85-mile stretch to Wacouna, seven days a week.

Landing facilities were more than primitive, consisting as they did of a 5,000-ft. sand and gravel strip at Knob Lake and a 4,000-ft. strip at Wacouna. On the first trip to Knob Lake the crew used the reversible-pitch propellers to brake the landing run, but they blew up such a storm of flying sand and gravel that it was decided to rely on the wheel brakes in order to avoid the terrific sand-blasting engines and propellers received.



Fifteen of these seven-ton International Harvester TD-14A diesel-engined crawler tractors were airlifted from Sept Isles to Knob Lake.

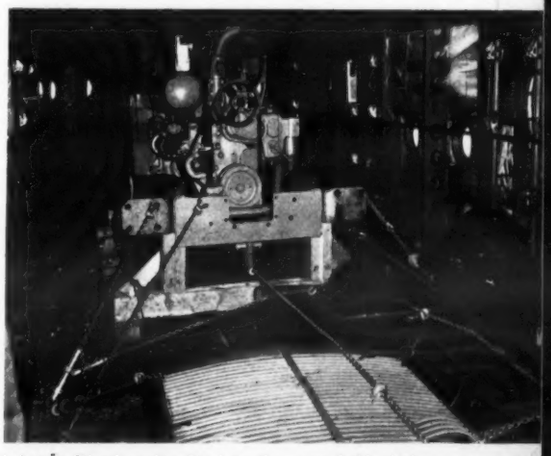
Tyres were cut to shreds by the rocky surface and brake linings ground away by sand long before they would have worn out in normal circumstances. An exception to the other landing points was Sept Isles, which has three hard-surfaced 6,000-ft. runways—a leftover from its war-time duties as a base for patrol bomber aircraft.

Flying itself presented a continuous problem. The only navigational aid was a radio beacon at Knob Lake, kept in operation by the personnel of the weather station there, which also acted as the control tower. Icing conditions prevailed at more than 1,000 feet throughout June and July, snow squalls were regular occurrences, and low ceilings were the rule rather than the exception.

Some of the more pleasant terrain on the Sept Isles-Knob Lake route. The region becomes more rugged towards the North (background).

Check points along the route consisted of a few distinctly shaped lakes among a myriad of shapeless ones, and occasional trading posts. Navigation instruments had a disconcerting habit of going haywire, since the compasses were seriously affected by the northern latitudes and by the iron ore beds along the route. Frequently the big "Packet" crawled into Knob Lake at 700 feet to stay below the cloud base and let down only after carefully going through more than the usual checklist for the landing procedure: "...wheels down, wing tips clear"—of the mountain!

"Operation Ungava" has shown several things beyond the fact that air cargo can sometimes do a job better than surface transport. It has proved that in certain circumstances it can perform tasks which surface transport simply could not accomplish and, what is more, that it is capable of making an isolated area accessible to surface transport. Finally, it has graphically demonstrated the value of civilian air cargo to national defence, for it is air cargo which will have been responsible for the arrival of the red-brown iron ore at the steel mills of the United States and thus, indirectly, for the steady supply of steel in various forms to the nation's defence plants.



A heavy Diesel engine fits into the cargo hold of the "Packet." Weighing seven tons, the engine must be firmly chained down to prevent its shifting during the 320-mile flight.

Air Beef

The Australian Meat Transport Company

All round Australia to market...

The youngest continent stubbornly resisted not only discovery, but also settlement... and still does. Settlers must have some means of livelihood in the interior. For this there must be roads or railways, which in turn cannot be built unless there are settlers.

Since the Japanese threat of invasion during World War II the settlement problem has if anything become even more acute, particularly in Northern Australia, which has mistakenly been regarded as desert land.

A glance at a map of the Australian railways gives the impression that it would not be worth while pushing forward from Port Darwin and Wyndham into the interior. But this impression would be mistaken. Within a radius of 300 miles of the two ports there stretch some of the richest pastures in the world. With its total herds of 14,000,000 cattle Australia occupies sixth place among cattle-raising nations. The reason why Australian beef is not better known abroad is solely that there have been no adequate communications with the coast. Droves of cattle had to be taken on the hoof to Wyndham and Townsville, the only places on the north coast where there were abattoirs. This trek frequently took weeks, and the cattle had lost considerably in weight (up to 100 lbs.) and quality when they arrived. Sometimes they couldn't be taken to either Wyndham or Townsville at all, because of epidemics or drought en route, and so had to be driven right across Queensland to the east coast. When slaughtered, the meat was generally sent to Perth, in the south-west corner of Australia. To get to market it had thus travelled all round the continent. The economic value of such transport methods need not be discussed.

Mr. Grabowsky intervenes...

Ian H. Grabowsky was not a business man by profession. During World War I he had served with the Royal Naval Air Service, then in 1920 had emigrated to Australia, where he became Chief Pilot and later manager of Guinea Airways.

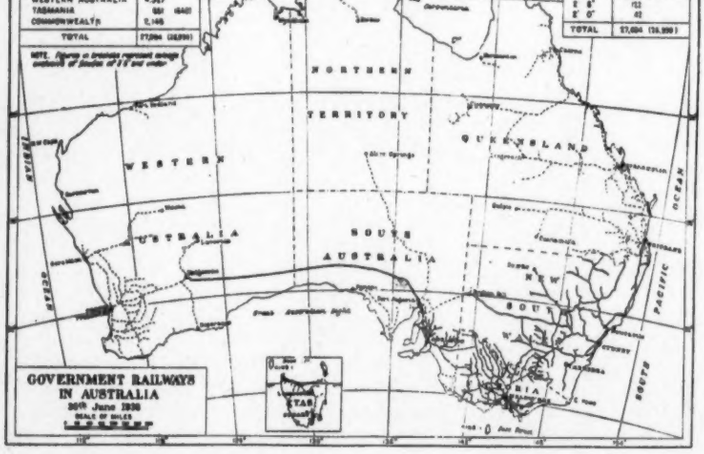
Business man or no, Grabowsky's calculation was extremely simple. If the losses in weight and quality during the trip to the coast were assumed to be no more than one percent—and in reality they were much higher—they meant an annual loss of nearly 4,000,000 lbs. of beef for 70,000 cattle—enough to cover the average meat consumption of 80,000 people. In addition every drove of 1,000 cattle had to have at least four mounted drovers, resting places and pasture during the journey had to be paid for, and only six-year-olds could stand up to the rigours of the trip. As the normal slaughtering age of a beef steer, however, should be not more than three years (as anyone can judge by his teeth), the inevitable result was that Australian beef reached the world market with a hopeless handicap.

Ian H. Grabowsky, Planning and Developments Manager for Australian National Airways, and one of the founders of Air Beef Pty. Ltd.

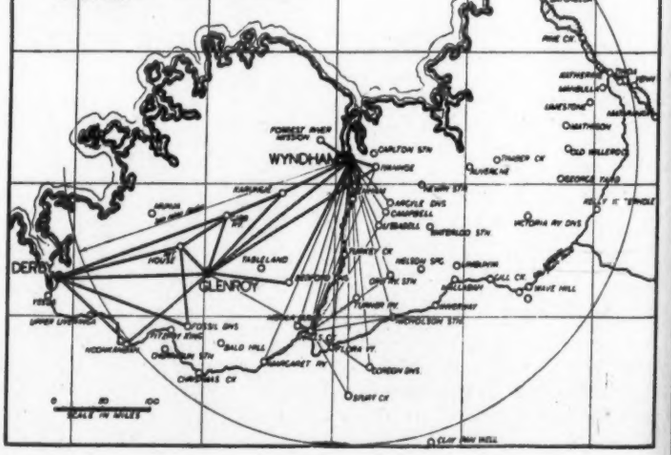
"These difficulties," it has been stated, "can only be overcome by building a close network of abattoirs throughout the interior—as in Brazil—with good connections with the coast."

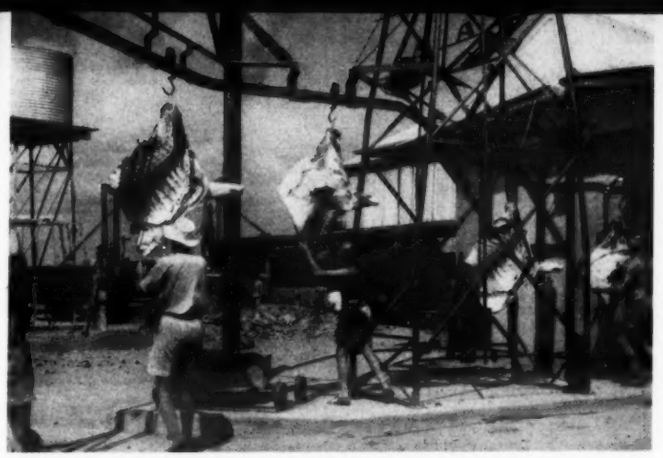
Good connections with the coast? "Utopia," asserted the experts... "Possible," said ex-war pilot Grabowsky. In 1936 he submitted a detailed plan to the Australian Federal Government calling for the construction of an abattoir in the Kimberley Division, the purchase of a twin-engined freight aircraft and the establishment of a meat

The map of the Australian railways gives the impression that the whole of the north of the continent is a wilderness. In reality there are large areas of valuable pasture and agricultural land.



Air Beef's "network" connecting the most isolated cattle stations of the Kimberley Division with the inland abattoir at Glenroy. From there the fresh-killed meat is flown to the port of Wyndham for shipment.





Loading quartered carcases at Glenroy abattoir. The carcases are carried by Monorail conveyor to the Bristol "Freighter."

transport undertaking. This plan was so long under examination by the authorities that it still had not been approved when World War II appeared on Australia's northern doorstep and led the Kimberley farmers and their livestock into the costly rush towards the south which has since been seen on cinema screens all over the world.

But steaks are flying now

Ian Grabowsky was tenacious. At the end of the war he again approached the Federal Government. Meanwhile he had become Planning and Developments Manager for Australian National Airways. By now he was no longer alone. Farmers in the Northern Territory had realized that the old-time losses were too costly. One of the staunchest of the plan's supporters, Gordon Blythe—owner of the Mount House cattle station, near Glenroy—plagued the Western Australian Government until it gave in. In November, 1948, "Air Beef Pty. Ltd." was formed, with head office in Glenroy. Principal shareholders were Australian National Airways, the "Mount House Pastoralist Company" and MacRobertson-Miller of the air charter company. The Western Australian Government made an interest-free loan of £10,000. And the MacRobertson-Miller Aviation Co. offered a Lockheed 10A. An experimental flight with a full load of beef slaughtered at Glenroy was made to Perth (about 1500 miles), where the beef was given to the Red Cross.

The Red Cross's protégés appear to have enjoyed these Glenroy steaks, for a mere eight weeks later, in January, 1949, three months before the beginning of the killing season, Glenroy became the scene of great activity. An abattoir, storage sheds, quarters for 25 men, messes, a mobile cinema were being built... all at a cost of less than a quarter of the £100,000 estimated by the pessimists. And two airfields, at Mount House and at Glenroy, were constructed by the farmers themselves for a total cost of £150.

The arithmetic was correct

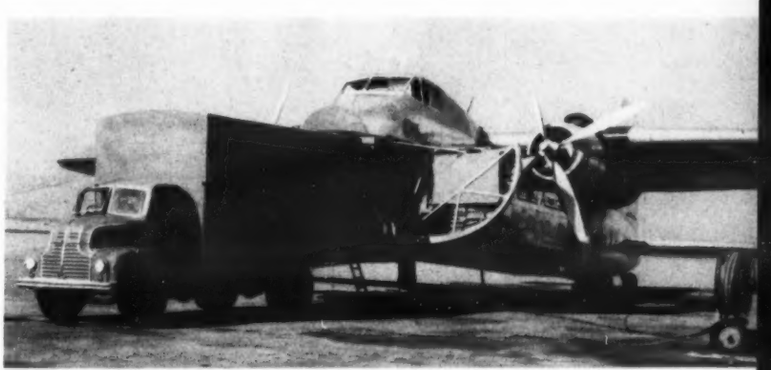
Would it pay to run the Glenroy abattoir and its "meat airport"? This was an anxious question that could only be answered by the practical results of the first killing season. The new Company had of course considerable expenses to meet, including the cost of chartering a DC-3. During the first season it could not pay the cattlemen more than 3*d.* per lb. for first grade beef.

Still, it has paid. Mount House's profit and loss account shows this. In the three years preceding the opening of Glenroy abattoir Mount House took 2348 cattle to the coast. The average weight of the meat from these cattle was 521 lb., and only 39.27% of it was accepted for export, *i.e.* as first grade meat able to command the highest price.

In 1949 and 1950, however, Mount House sent 3100 cattle to market with an average weight of 600 lbs., and no less than 85.11% of the meat was found to be of export quality.

Air Beef, too, was doing well. Not only Mount House supplied their whole stock of slaughtering cattle to Glenroy. The cattlemen of Gibb River, Bedford, Karungie, Fossil Downs, Tableland... all were anxious to make use of Air Beef's DC-3, which had cut down the journey from pasture to seaport from 90 days to 70 minutes.

By the end of the 1949 season Air Beef was able to put a brand-new Bristol "Freighter" into service. No more charter fees had to be paid, and Grabowsky estimated that 4,500 cattle would be handled during the 1950 killing season. This hope, however, was not fulfilled because of a six-month drought, which gave Air Beef a bad financial year. Killing even had to be stopped three weeks earlier than planned. Nevertheless 3,700 cattle were handled, and the third season, which closed in September, 1951, increased this figure to 4,080.



The "flying steak" takes only 70 minutes from Glenroy to Wyndham, where it is taken to cold storage in special trucks.

Air Beef's "Freighter" on arrival at Melbourne at the end of the season.

*

Today all doubts as to the viability of an air transport scheme for meat in northern Australia have been banished. On it's return flight from Wyndham Air Beef's "Freighter" carries building material to Hall's Creek, where a second inland abattoir is being constructed, and Grabowsky is seizing every opportunity to encourage the use of aircraft for the transport of fresh-killed meat throughout the Australian Continent. Economic developments seem to be on his side. An Anglo-Australian meat agreement signed in London in mid-October provides for a large-scale expansion of cattle-raising in Australia over the next 15 years, and Great Britain is to help finance not only this expansion, but also the transport of the chilled meat.

Basically Air Beef and its managers are not campaigning only for a more rational handling of meat. Their successful experiment has also furthered the whole idea of air freight. It shows that the undeveloped regions of the world can provide valuable pioneer work in this youngest branch of air transport. Australia is already showing the way. With its 42,395,000 tonne-kilometres, Australian operators took third place in international air freight traffic in 1950. And if increasing use of the aircraft leads to increasing settlement of the interior, figures will doubtless rise by several million tonne-kilometres during the next few years.

What's in the Air ? *

DEFENCE PRODUCTION AND STRIKE FEVER

Early in 1951 President Truman complained that the monthly output of American military aircraft was lagging far behind the planned figure. However, some improvement seems to have taken place during the summer. According to a report issued at the end of September, monthly output had increased by 50 to roughly (?) 400 aircraft. However, about 10% of these aircraft could not be put into immediate service, because the bottleneck in engine and accessories production has not been overcome. So as not to deprive the U.S. aircraft factories of needed working capital, the USAF is taking the aircraft without full equipment.

Prospects of speeding up engine production are not particularly bright at the moment. On September 23rd 13,000 workers from Wright Aeronautical Corp.'s aircraft engine plant at Wood Ridge (N.J.) went on strike, after wage negotiations between the management and the United Auto Workers (CIO) had broken down. This strike meant a halt in the production of J-65 "Sapphire" jets, which are being made in large quantities under licence from Armstrong-Siddeley. However, the strikers agreed on October 2nd to prepare for shipment spare parts urgently needed for the USAF (. . .cold comfort).

Workers from the Douglas plants at Long Beach, El Segundo and Santa Monica (10,000 strong) went on strike on September 6th, and by mid-October no solution had been found. Negotiations between Donald W. Douglas and John W. Livingston, National Director of the United Automobile Workers, held at the request of the Conciliation Board, failed to produce agreement.

The management of Lockheed Aircraft Corp., Burbank (Calif.), have been able to avert a strike only by granting the 19,200 workers paid by the hour a wage increase of 8% with effect from August 13th.

On the other hand building workers on the Paducah (Ky.) atomic energy project went on strike at the same time as the Wright Aeronautical Corp. workers, and work on the Dana (Ind.) atomic energy plant came to a stop when 1500 fitters and welders belonging to the American Federation of Labour downed tools.

If, however, the present strike fever can be cured, there will be little need for pessimism.

For example, McDonnell Aircraft Corp. made a net profit of $3,291,262 during the 1950/51 financial year (up to June 30th), as compared with $2,815,219 during the previous year. The firm will probably be fully occupied up to April 1952 with production of the F2H-2 "Banshee" carrier-based jet fighter. Then it is to start on quantity production of the improved F2H-3 "Banshee." A few weeks ago first deliveries were also made of the F2H-2P photographic reconnaissance aircraft.

Reference was made in our last issue to the exceptionally high total of orders on the books of Lockheed Aircraft Corp. Since then Robert E. Gross, Lockheed's President, has announced that the firm has work enough for 2 to 2½ years. If the net profit for the second half of 1951 does not exceed that for the first half ($4,047,476) this will be solely because of the shortage of labour and inadequate supplies of raw materials and engines.

W.F. Shaylor joined *de Havilland Engine Co. Ltd.*, as *Commercial Manager* on September 1st, 1951. Previously he had been 14 years with Airspeed, ending up as Works Manager.

As regards raw materials the forecast of a shortage of aluminium has fortunately proved to be a false alarm. The acute production crisis in the aluminium works of the north western States caused by shortage of electricity—a crisis which had already led to serious discussion of moving the whole industry—has been overcome for the time being, thanks to heavy rainfall in the States of Washington and Oregon. Early in October the Defense Production Administration allocated an additional 1,000,000 lbs. of aluminium to aircraft rivet manufacturers (in addition to the 1,500,000 lbs. already allotted). Present estimates put requirements for the first quarter of 1952 at not more than 2,800,000 of aluminium rivets.

DOES MONEY ALONE COUNT ?

Interavia has frequently reported on U.S. plans for non-subsidized air transportation. These plans now seem to be about to be put into effect. If the House of Representatives accepts a bill passed by the Senate on September 19th, the American air transport companies will in future have to make do with very small subsidies. Government expenditure on air transport is to be divided into two separate headings (starting on July 1st, 1952, for overseas traffic), which are to be budgeted for by two different departments:

1) for the carriage of mail the U.S. postal administration will pay a sum based on actual operating costs;

2) the fund from which subsidies would be paid will be administered by the Civil Aeronautics Board.

That largesse from this subsidy fund will not exactly be distributed with open hands has already been made clear. By 53 votes to 23 the Senate rejected a clause in the bill that would have empowered CAB to subsidize any company, regardless of whether it was a mail carrier or not.

*

American air transportation is well on the way towards economic independence and, financially, is well ahead of all other countries. Recent ICAO statistics (Financial Data: Digest of Statistics No. 18) once more show this very clearly. In 1949—*i.e.* before the present boom conditions—12 out of 37 international airlines reported an excess of operating receipts over expenditure. No fewer than nine of these twelve have their headquarters in the USA (American Airlines, Braniff, Chicago & Southern, Eastern, Northwest, PAA, Panagra, TWA, United).

A survey of air traffic development during the past 15 years, which appeared at the same time, gives statistics from 44 countries up to March 31st, 1951 (Scheduled Airline Operations; Digest No. 15). If the operating results for the U.S. airlines are compared with the total results for the six leading European countries (Britain, France, Holland, Sweden, Norway, Denmark), the following picture is obtained:

* Extracts from INTERAVIA AIR LETTER, Daily international news digest, in English and French. All rights reserved.

Exercise Pinnacle, the *RAF's autumn exercise* organized to test the preparedness of British air defences (photos : *Crown Copyright*).

Air Chief Marshal Sir Hugh P. Lloyd, Air Officer Commanding-in-Chief, Bomber Command (right) initiating his Staff officers into the plans for the attack. (Left to right) Group Captain J. N. Tomes (Operations Officer) ; Air Vice Marshal G. D. Harvey (Senior Air Staff Officer) ; Wing Commander D. E. A. Williams (Navigation Officer).

A "Vampire" on "Exercise Pinnacle" refuelling at Odiham RAF station.

The twin-engined *Martin* 4-0-4 airliner obtained its type certificate from the Civil Aeronautics Administration early in October, 1951. C. C. Pearson (left), president of The Glenn L. Martin Co., receiving the certificate from Frederick B. Lee, deputy administrator of CAA, with Ernest Henley, director of air safety, CAA and W. B. Bergen, Martin's vice-president-chief engineer, looking on.

On October 5th the prototype of the "*Convair-Liner 340*" (44 passengers) started its *flight tests*. Five windows have been omitted to facilitate installation of test equipment.

	U.S. Air traffic		European air traffic (six countries)	
	Aircraft km	Passenger km	Aircraft km	Passenger km
1937	120,219	748,808	41,470	201,812
1947	662,289	12,736,325	145,896	2,065,250
1948	702,110	12,665,561	163,074	2,724,234
1949	738,726	14,184,203	163,862	3,014,340
1950	758,996	16,444,829	— *	—*

* No English figures yet available for 1950. Results excluding Britain are : 107,589 aircraft km; 2,423,083 passenger km.

It would, of course, be foolish to compare the bare figures without making allowance for the greater political unity and the stronger purchasing power of the USA. Nevertheless, the question arises of whether the only reason for the Americans' success is really their "bigger purse." Does not their greater initiative also come into it?

This can be illustrated by a few reports from the past month, which reflect the air rate policies of Old and New Worlds.

Eastern Air Lines have carried over 500,000 passengers on second class services during the past two years (since September 25th, 1949). Today the company sells more second class tickets than all other airlines.

Braniff International Airways, who opened a new South America service in mid-October, is to run the Miami-South America section five times a week with Douglas DC-6s and twice—tourist services—with DC-4s, the difference in price between first and second class being a full 25%.

What about Europe? Here, too, attempts are being made to bring rates more into line with present-day conditions. For example, early in October, Aer Lingus, the Irish Airlines, announced reductions on all its continental services, ranging from 3½% (Dublin-Amsterdam) to 11% (Dublin-Liverpool). Similarly the French line, Compagnie des Transports Aériens Intercontinentaux, has reduced rates on its African services by up to 20%... but only during the Paris Motor Show (October 4th to 20th). On the other hand British European Airways have been obliged, even though the off-season is setting in, to introduce increased fares on all cross-Channel services to take effect from mid-October and to be supplemented by increases in excursion rates (up to 10%). Announcement of these increases was accompanied by an assurance that they would not affect the IATA companies' efforts to introduce reduced-rate second class fares... but the only visible result so far is the increase.

To reproach BEA for this decision—which will have been very carefully weighed—is out of the question. However, it is noticeable that European air transport as a whole is lacking in the adaptability, the "streamlining," which distinguishes the American companies. European air transport is still a bit disorganized, and it is easy to understand why Count Sforza, Italy's Minister of State, should once more have stressed, during his recent visit to the U.S., the advantages of his plan for forming a political and economic union for Western European air transport, creating a supra-national European air transport authority and doing away with "frontiers in the air."

On the subject of "streamlining" in U.S. air transportation, a relatively insignificant event of the early part of October speaks volumes. If the recommendations of a Civil Aeronautics Board examiner are followed, students of Purdue University may shortly have their own commercial airline for study purposes. An affiliate of the University, the Purdue Research Foundation, is planning to buy Mid-West Airlines (formerly Iowa Airplane Co.), which runs local services in Nebraska. Purchase price: $69,000. A plan for modernizing the air fleet (with DC-3s) is also said to have been made.—$69,000 is a lot of money, and the additional $1,000,000 which is to be spent on reorganizing the company is a handsome sum by European standards... But certain European institutes have before now found similar sums for far less reasonable purposes.

Needless to say, we are not advocating an immediate slavish imitation of this American example. Nor are we even suggesting that all European air fares should be reduced forthwith. The somewhat worn disc of "America the Perfect" shouldn't be played too often. What could well be asked of European air transport is simply a little more elasticity and a consciousness of its *raison d'être* within the national economy of the various countries concerned.

AIR RAID SIRENS, UNMANNED BOMBERS AND POLAR BASES

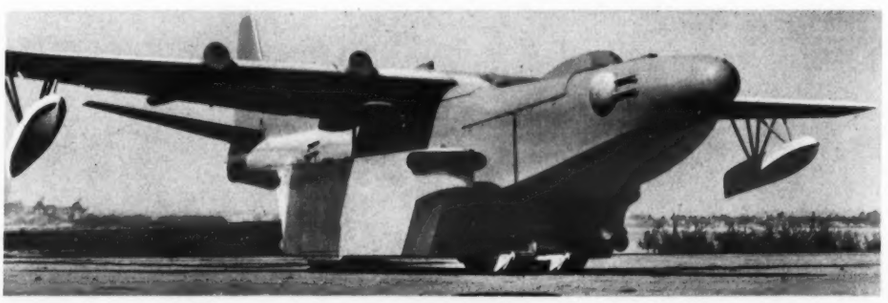
Defence preparations are gradually making themselves felt in everyday life—not only in the taxpayer's pocket.

During "Exercise Pinnacle," the large-scale British air exercises held from September 29th to October 7th, the Air Ministry warned the public against "window," the strips of metal foil dropped from aircraft to mislead the radar. These strips may cause accidents when in contact with electric cables and should be left to the local electricity authorities to remove.

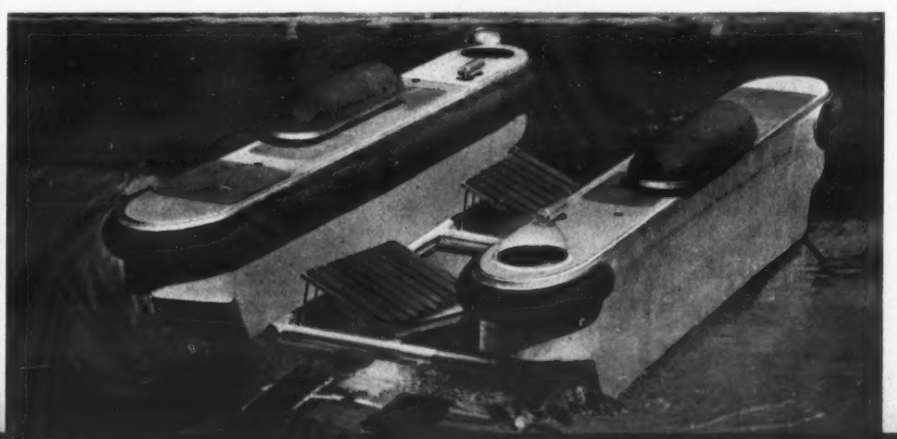
It looks as if there will be no shortage of "war noises" at any rate. A new air raid warning siren produced by the Chrysler Corporation, and recently demonstrated to representatives of the USAF and civil defence, is said to have a noise impact of 170 decibels and to be clearly audible within a range of 7½ miles. It is driven by a 140 h.p. engine and weighs 2½ tons.—Another siren with electronic amplifier, recently designed by Robert Ritschie, of Los Angeles, can be mounted on a car and has a range of no more than 3 miles.

More interesting news, however, comes of strictly military innovations. On October 1st the USAF's first pilotless bomber squadron (equipped with the new tactical guided missile, the Martin B-61 "Matador") was activated at Patrick Air Force Base, near Cocoa (Fla.). However, the Base's Public Relations Officer has stated that "it will be quite some time before the squadron is fully manned."

"Boeing Magazine," Boeing Airplane Co.'s house journal, reports that the USAF is contemplating the use of floating ice islands as bomber bases. The islands are said to have already been charted by B-29 "Superfortress" crews during their polar missions.—This idea goes back to a British World War II project, which envisaged the building of artificial ice islands out of a mixture of ice and sawdust ("Pykerete"). These were to carry their own refrigerating plant to retard thawing if the island floated into warmer water.



Dry dock for flying boats : the Edo Corporation of College Point, Long Island, has developed this dry dock for the new flying boats ordered from Convair by the United States Navy (span 146 ft., length 130 ft., gross weight 80 tons).



Finally, a brief supplementary note to last month's survey: the U.S. military estimates for 1951/52, now passed by both Houses of Congress and presented to President Truman for signature, exceed the recommendations of the Budget Committee by nearly $1,000,000,000. Instead of the original figure of $56,062,405,890 proposed, $56,937,808,030 was granted, out of which the USAF is to get not $19,854,128,000, but $20,642,785,000.

Flight testing of the Fiat G.80 is taking place at Amendola (Apulia) military air base.

The Fiat G.80

In the spring of 1949 Fiat's Turin works announced the development of a jet-powered fighter trainer; towards the end of 1951 the first prototype of the G.80 was completed. Professor G. Gabrielli, one of the most successful designers in the Italian aircraft industry, and his colleagues have thus produced Italy's first jet trainer in a bare two and a half years. The need for this aircraft is acute, since the speed-up in the equipment of the Italian Air Force's fighter units with jet aircraft necessitates the provision of a suitable machine for training purposes.

The new all-metal low-wing monoplane has a wing in three sections with slightly swept leading edge, straight trailing edge and removable wing tips. Its span is 36 ft. 1 in., wing area 269 sq.ft., and aspect ratio 5.0. With larger wing tips the wing area can be increased to 290 sq.ft. and the aspect ratio to 6.0.—The fuselage, 40 ft. 8 in. in length, is of monocoque construction and also divided into three sections: front section with nose wheel and lateral air intakes; centre section with power plant and wing junctions; rear section with jet pipe and tail unit. The undercarriage is hydraulically retractable; ejector seats in tandem, pressurization and complete blind flying instrumentation are included in the standard equipment.

The G.80 is primarily a two-seater. It can be fitted alternatively with de Havilland "Goblin" (thrust 3,500 lbs.) or Rolls-Royce "Nene" (thrust 5,000 lbs.). Depending on the engine used, the aircraft, which has a gross weight of 11,900 lbs., develops a maximum speed of 547 m.p.h. or 572 m.p.h. It will be capable of climbing to 29,520 ft. in 15½ or 7 minutes, and its service ceiling will be 44,290 or 49,210 ft.—This high performance and the fact that a single-seater version has been announced would appear to indicate that the G.80 may later be used as an operational fighter.

Book Reviews

L'uomo in volo — Manuale di medicina aeronautica. Prof. Tommaso Lo Monaco Croce. Published by Abruzzini, Rome, 1950.

This handy, comprehensive and profusely illustrated manual by the head of the Italian Aviation Medical Research Centre, Rome, and his colleagues, Dr. A. Scano, Dr. G. Lalli and R. Vannutelli, deals in highly competent manner with all the medical problems of present-day aviation. Introductions by Lieut.-General Mario Pezzi (altitude record of 17,083 m. in 1938) and General Alberto Marulli recommend the book from the point of view of the pilot and the medical specialist. It's 29 chapters, supplemented by 281 illustrations and 25 tables, describe the psychophysical effects of normal flight, high altitude flight, high speed flight, aerobatics and even space travel, and give special attention to the problems of parachute jumping, the ejector seat, first aid in the event of air accidents, prevention of the spread of sickness due to aviation, etc. If this excellent book were translated into the leading world languages, it might well become a standard reference work for flying and medical personnel throughout the world. (Italian)

Ri.

L'Essentiel de l'Art du Pilotage. A.-P. Monville and A. Costa. Published by Librairie Aéronautique, Editions Chiron, Paris, 1951.

This handy, well illustrated little book, intended for the use of pupils and instructors at civil flying schools, of sporting pilots and aero clubs, is an extract from the manual, *L'Art du Pilotage*, five editions of which have already appeared (the remaining chapters from this manual are also to be reprinted, the next one due being *Les Acrobatics*). The book draws on a rich fund of experience, giving in clear, concise form the essential information supplemented by practical advice. (French)

Ri.

Aircraft Designers' Data Book. Leslie E. Neville. Published by McGraw-Hill Book Company, Inc., New York, 1950.

All engineers engaged on the design of new aircraft and engine types know that there is much to be learned from a thorough study of well-known older designs, and the above work provides an excellent opportunity for this study. The book contains 788 diagrams, sectional drawings and illustrations—many of them using the isometric method of graphic representation—of details and whole assembly groups of some of the best-known of American, Western European and Eastern aircraft types. Engines (particularly turbine engines) and a selection of aircraft and engine accessories are dealt with in similar fashion. Neville's book, which also contains data on the most important aircraft types, piston and turbine engines, and details of American propellers in table form, is to be recommended to all engineers and technicians in the aircraft industry. (English)

Ba.

Der Segelflug-Modellbau in Theorie und Praxis. Alfried Gymnich. Published by Otto Maier, Ravensburg, 1951.

Whatever the Germans do, they do thoroughly... The 164 pages and over 100 illustrations in this book offer the model builder more of the theory of flying than the average aircraft engineer knows. At the same time the practical side—in workshop and in flight—is also given its due. For example it is a real pleasure to read the chapter on "test flying" the models. The author is at pains to give comprehensive instructions for successful model building and gives a series of examples of known models. There are introductions by Oskar Ursinus and Wolf Hirth, both of whom stress the importance of model building in making youth airminded. (German)

Ri.

Douglas C-124A Cargo Transport

By S.S. KREISLER, Preliminary Design Engineer of the Douglas Aircraft Co., Long Beach, Cal. [1]

The C-124A " Globemaster II " airplane is a heavy cargo, multi-purpose, strategic transport designed and built for the Air Forces by the Douglas Aircraft Company, Long Beach Division. The basic military requirements established for the airplane were developed by the Air Forces in conjunction with the Army Ground Forces so that the airplane would have the requisite qualifications of both organizations with respect to air transportation. The C-124A is the first and only cargo aircraft in existence that can transport practically *any type of military cargo*. It has made a tremendous stride forward with respect to increasing the weight and size of freight that may be transported by air, and because of this, new fields of military operations now become feasible.

A general description of the airplane's cargo handling and design features will help to explain the military potentialities that may be realized by a fleet of these aircraft.

The Globemaster II, at its design gross weight of 175,000 lbs. (79,380 kg), can transport a payload of approximately 50,000 lbs. (22,680 kg) for a distance of 850 statute miles (1370 km) with allowances for reserve fuel, and return without refuelling. The equivalent range is 1,570 statute miles (2,520 km). Payload and range can be greatly increased by operating at alternate gross weight and maximum alternate gross weight.[2]

The airplane can be used to carry all types of military cargos in many different combinations and can also be used as a troop transport. It can, for example, transport the following :

1. *Personnel* — The airplane has troop seat accommodations for 200 men, 102 on the auxiliary floor and 98 on the main floor. Two paratroop doors are being incorporated, enabling the airplane to conduct paratroop missions. In this type of operation, the aft loading well is also available for dropping bulky equipment.
2. *Litter Patients* — The airplane has accommodations for 127 litters plus 25 seats for attendants and ambulatory cases. Litters can be rapidly loaded or unloaded by using both ramps and the loading elevator.
3. *Cargo* — Practically any spare part for any Air Force type aircraft can be readily handled. The " Globemaster II " can load items such as crated reciprocating, turboprop, or jet engines as well as any complete demountable power plant or fully assembled 19½ ft. (6 m) propellers. It can carry B-36 tail surfaces and outer wing panels, or entire, but partially disassembled, fighters, helicopters, or liaison type aircraft.
4. *Vehicles* — The airplane can transport all varieties of motor vehicles. Approximately 94% of the vehicles listed in the Military Vehicle Catalog TM9-2800 may be transported without disassembly. For example, it is possible to carry (1) the largest types of earth-moving equipment such as bulldozers, scrapers and graders, (2) almost all types of trucks, including maintenance trucks, (3) trailers, including the large radar trailers, (4) light tanks such as the M-24 or T-37 which have a fighting weight of 40,000 to 50,000 pounds, and (5) guns such as the 155 millimeter Long-Tom, the 8-inch gun, or the 240 millimeter howitzer on a transport wagon. The unwieldy motorized cranes and other bulky items of the engineer's equip-

Fig. 1 : The Douglas C-124A " Globemaster II " (four 3500 h.p. Pratt & Whitney R-4350 " Wasp Majors ") carries 50,000 lbs. useful load over 2,400 miles (take-off at extra load) or 29,000 lbs. over 3,530 miles.

[1] Paper read to the American Society of Mechanical Engineers.

[2] In May of this year a C-124A took off from Edwards Air Force Base, carrying a gross weight of 210,000 lbs. (95,250 kg). This weight included over 70,000 lbs. (31,750 kg) of simulated cargo. The aircraft was flown to an airport 1,000 miles away (1600 km), unloaded and returned to base without refuelling.

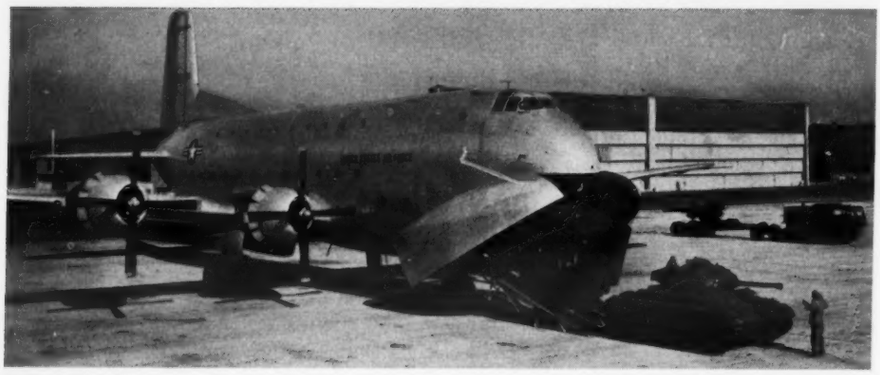


Fig. 2: 94% of all U.S. military vehicles can be carried without dismantling. A 2½-ton truck (weighing 9,900 lbs. empty) and a M-24 light tank (fighting weight 40,000 lbs) being loaded in a transport belonging to the 3rd Strategic Support Squadron. A M-1 8-in howitzer (fighting weight 29,700 lbs.) with its M 5 A 3 tractor (22,000 lbs. empty weight) is waiting to be loaded.

ment can also be carried in the C-124A airplane.

The maximum payload is not usually reached with a single vehicle, even when the standard M-24 light tank is transported. Inasmuch as its fighting weight is only 40,000 pounds, the simultaneous loading of a 2½-ton 6×6 cargo truck is possible (Fig. 2). Three fully loaded 2½-ton 6×6 trucks would constitute another airplane load.[3] The fuselage loading opening was designed to accommodate the largest vehicles permitted on U.S. highways. After these dimensions were established, the Ground Forces requested that the width be increased 6 ins. (152 mm) so the airplane could carry their new light tank, then under development, and the width was increased accordingly. As a result, the fuselage opening is 136 ins. (3.45 m) wide by 140 ins. (3.56 m) high, and the cargo compartment has a volume of *10,400 cubic feet = 294 m³*.

Fig. 3: Dimensions of the fuselage doors were worked out on mock-ups.

Now that airplanes can carry such large items of equipment and such heavy loads of diversified cargo, it would save a great deal of time and effort if specially trained men were available to supervise the loading. When such equipment is transported by rail or ship, special loading cranes, chocking materials, and tie down equipment are required, and personnel who are familiar with loading restrictions and regulations must supervise the operation. There are so many new types of loading facilities available in the C-124A airplanes that unless the loading chief is fully aware of handling techniques and restrictions and is familiar with the operation of the loading ramps, travelling hoists, auxiliary floors, loading elevator, and military vehicles, the airplanes cannot be utilized to the greatest advantage.

Rapid air transportation of cargo is worthless unless the cargo can be expedited to the fighting fronts. Usually the landing fields are fairly distant from the combat areas and the final transportation of freight must be accomplished by truck or helicopter, except for specialized operations when cargo parachutes can be utilized.

In order to alleviate the handling problems, loading of large quantities of general cargo should be accomplished with van type trucks or trailers (Fig. 4), or by palletizing the cargo so that it may be loaded in bulk form. The travelling cranes of the C-124A may be used for hoisting operations; or trailers as well as sled type pallets hooked together into a train may be towed up the ramps and into the airplane with the aid of the towing provisions that have been incorporated (Fig. 5).

For arctic operations, tremendous advantages can be obtained by flying-in insulated and heated trucks and trailers that are completely equipped for maintenance work, radar installations, hospital facilities, and various other uses. During operation "Swarmer", the C-124A airplane carried a token load consisting of a 2½-ton 6×6 high lift truck which weighed 12,000 pounds. It took 5 minutes from the time the airplane wheels touched the ground until the truck was out of the airplane. If three trucks had been carried, it would have taken only 8 minutes to unload them.

By considering the airborne possibilities of vehicles in their future design and procurement, the efficiency of both ground and air transportation may be greatly increased. By designing trucks and trailers with rapidly removable van type or cargo type bodies, complete mobile units may be moved by air, or increased payloads can be handled rapidly by transporting the basic cargo container. If a rigorous weight conservation programme is conducted in the design and procurement of ground vehicles, their cargo payload can be increased as well as the airborne payload with no compromises required of the basic aircraft or of the vehicular requirements. The creation of lightweight, trailer mounted, mobile tank units for handling aircraft fuels (Fig. 6) would provide a useful link in the Armed Services transport system. Such tanks should be equipped with their own mounting cradles and tie down provisions so that they may be detached and moved on their own skids, sideways and lengthwise, as occasion demands, to the bed of a flat car, trailer, or the cargo deck of an airplane. The size of the main cargo compartment of the C-124A airplane permits the loading of

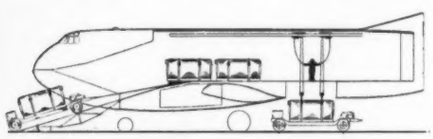
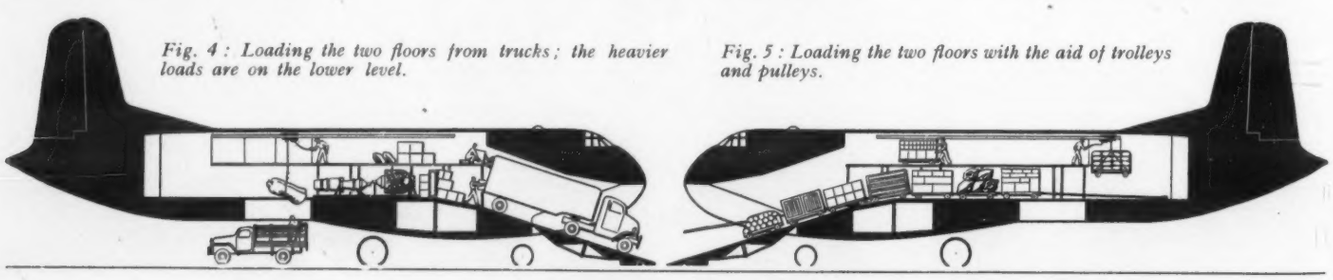


Fig. 6: Carrying aircraft fuel by air in special containers, loading from flat cars.

[3] When fully loaded trucks are driven into the aircraft, loading and unloading of supplies takes only 15 minutes compared with the normal two hours. Moreover, the trucks are ready for immediate use on arrival at destination.

Fig. 4: Loading the two floors from trucks; the heavier loads are on the lower level.

Fig. 5: Loading the two floors with the aid of trolleys and pulleys.



containers identical to those currently used on railway flatcars.

To handle such diversified types of cargo efficiently the following loading features have been incorporated in the " Globemaster II " :

1. Nose loading doors that can be unlatched, opened, and a ramp that can be lowered in approximately 40 seconds.
2. Nose loading ramps having a design capacity of 50,000 pounds.
3. Aft cargo loading well doors that can be unlatched, opened, and the elevator platform lowered in approximately 40 seconds. These aft doors can be opened in flight for aerial supply operations.
4. An elevator platform that can lift or descend 10 ft. in 25 seconds (7 m/min.) with loads up to 8,000 lbs. (3650 kg). It is 13 ft. 4 ins. (4.05 m) long by 7 ft. 8 ins. (2.35 m) wide, and a load of 14,000 lbs. (6350 kg) may be stowed on the loading platform during flight.
5. Travelling cranes that are used in operating the platform and that can be disconnected from it and used as hoists with a capacity of 16,000 pounds. They can be power traversed fore and aft.
6. A main cargo compartment that has an effective volume of 10,400 cubic feet (294 m^3), is approximately 12 ft. (3.65 m) wide, 12 ft. (3.65 m) high and 77 ft. (23.5 m) long.
7. Tie down fittings, with rated strengths as high as 50,000 lbs. (23 tonnes) that have been designed to restrain heavy vehicles and machinery. Methods of lashing vehicles have been evolved so that with approximately 10 ties per vehicle, restraint is provided for 3.2 " g " upload or 1.5 " g " forward, aft, or to the side. Such tie down restraint may be obtained for a single 50,000-pound vehicle or any combination of lighter vehicles.
8. A cargo floor that is capable of handling a 20,000-lb. (9-tonnes) individual axle load or 40,000 lbs. (18 tonnes) on tandem axles. The allowable unit loading on the treadway areas is 80 pounds per square inch. This corresponds to 11,520 lbs. (56 tonnes/m^2) per square foot ; whereas normal commercial cargo aircraft have allowable floor loadings of approximately 250 lbs (1.2 tonnes/m^2) per square foot.
9. Pulleys are provided that have sufficient capacity to permit winching 50,000-lb. (23 tonnes) vehicles into the airplane by use of a Prime Mover located outside the aircraft.
10. Auxiliary floors are provided for better handling of low density cargo, and to utilize efficiently the tall-cargo compartment that is required for vehicular transport. These floors create a second deck and may be stowed up or down against the airplane sides or may be readily removed.

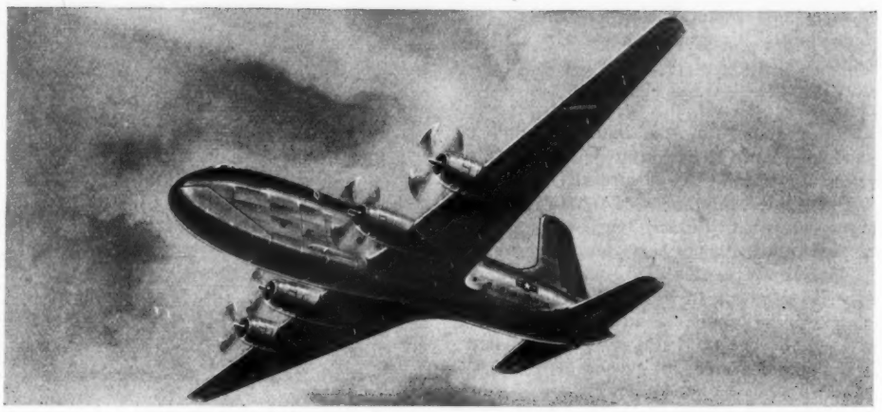


Fig. 7 : Design drawing of the C-124A " Globemaster II ".

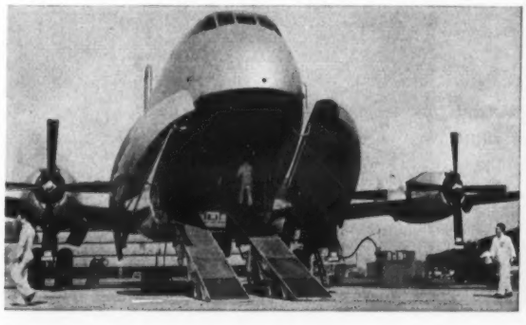
Span :	173 ft. 3 ins.	Wing area :	2,510 sq. ft.
Length :	127 ft. 2 ins.	Gross weight :	175,000 lbs.
Height :	48 ft. 4 ins.	Take-off power :	14,000 h.p.

The heavy payload capacity and long range ability of the C-124A may be utilized for large scale air movements of infantry or paratroopers. A fleet of 80 " Globemaster II " aircraft could in one mass flight transport all the personnel of an entire airborne division from Westover to Brest with two refuelling stops. This operation was assumed at the alternate gross weight with refuelling stops at Goose Bay and Iceland. Enough fuel was also allowed for the last hop so that no refuelling would be required at Brest. It was further assumed that the division consisted of 16,000 men allowing 240 lbs. (109 kg) per man. One subsequent trip, with the same fleet, could be used to transport the division's equipment amounting to approximately 2,500 tons (approx. 2300 tonnes).

Another interesting method of using the C-124A is at take-off weights of less than the design weight ; for example, in establishing an air-head, if earth-moving equipment is required to set up an improved landing strip for operations of bombardment or fighter aircraft, the following type of flight may be required : Assume that a 12 cu.yd. motorized scraper, weighing 31,000 lbs. (14 tonnes) ; or a motorized grader, weighing 24,000 lbs ; or one of the largest bulldozers, 61 to 90 draw bar horsepower, weighing 32,000 lbs. (14.5 tonnes) is required to prepare the airstrip. Also, assume that radius of operation can be reduced to 400 statute miles (640 km), then the take-off gross weight would be approximately 145,500 lbs. (66 tonnes) with a single vehicle load, and the landing weight at the advanced base would be about 138,600 lbs. (63 tonnes). Under these conditions, the take-off distance over the 50-ft. (15 m) obstacle at the home base (at which an improved field would be available) would be 3,250 ft. (1000 m). The landing distance over a 50-ft. (15 m) obstacle, with reverse thrust, at the advanced base would require 2,070 ft. (630 m). The actual landing ground roll would be approximately 970 ft. (ca. 300 m), and the take-off distance ground run for the return trip would be 1,350 ft. (410 m). Under these conditions, it can then be seen that the length of field required is not excessive.

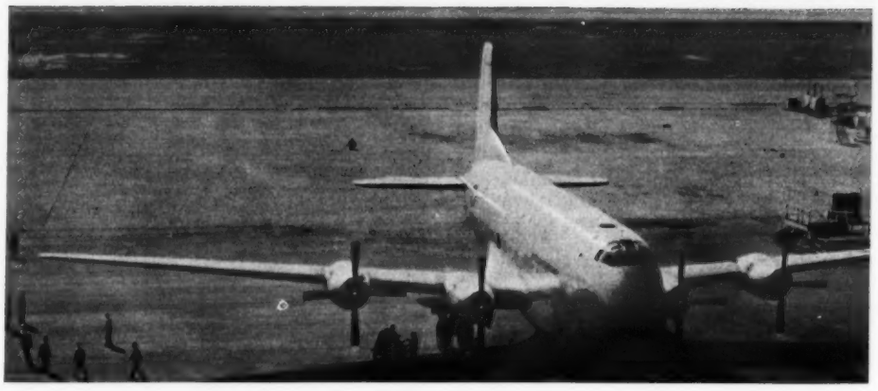
Because of the lowered take-off gross weight and the large tyres, the ground pressure or tyre pressure of the C-124A may be reduced to approximately 34 lbs./sq.in.

Figs. 8 and 9 : Thanks to its large clam-shell doors and rear loading hatch the C-124A can be loaded and unloaded exceptionally fast.



(2.4 kg/cm²) by operating at a 42 % tyre deflection. This ground pressure is actually below that of a C-47 which requires approximately 43 pounds per square inch at design conditions. Hence, the type of strip preparation required for the landing would be somewhat equivalent to that which would be necessary for C-47 type aircraft.

Eventual development of the airplane will result in substitution of turboprop engines of increased horsepower for the present R-4360 power plants [4]. The "Globemaster II" is well suited for such power plants because of its aerodynamic cleanness (being flush riveted throughout), full span slotted flaps, and comparatively large wing area of 2,510 sq.ft. (233.2 m²). By installing the turboprop engines which are at present available and making the necessary modifications, it would be possible to increase the design take-off gross weight to 200,000 pounds. Under these conditions, the payload and the range are both increased and take-off distance is decreased. These factors coupled with the resulting increases in speed would result in appreciable reductions in operating costs.



[4] The new model, designated the YC-124B, is to have Pratt & Whitney YT 34-P-1 propeller turbines with a take-off performance of 5,500 h.p. each and Curtiss three-bladed propellers with a diameter of 18 ft. It will also have a pressurized flight compartment and heating equipment for de-icing the wing leading edges. With a gross weight of 200,000 lbs. (90,700 kg), the design useful load is 64,000 lbs. (29 tonnes) ; however, payloads in excess of 75,000 lbs. (34 tonnes) can be carried if required. The prototype is to make its first flights in the spring of 1952.

The V.H.F. Omni-Range

By Dr. Ernst Kramar, Stuttgart

To keep pace with the constant growth of air transportation, the U.S. Civil Aeronautics Administration has in recent years been modernizing its ground equipment for radio navigation and air traffic control. The following main changes have been made :—

— Conversion from MF W/T to VHF R/T for communications ;

— Replacement of MF radio ranges by VHF omni-ranges (VOR) for short-range navigation ;

— Organization of an air traffic control system with radar, firstly around the airports (Airport Surveillance Radar), and later on the air routes.

Europe is following the same path, in part for economic reasons, since to keep down airborne equipment on intercontinental aircraft to a minimum the ground equipment in both continents must be similar, but also because careful investigation of all the problems involved has led to the same conclusions as those reached in the U.S. The use of higher frequencies [1] gives the following advantages :

— Extremely low sensitivity to atmospheric interference ;

— Saving in space and weight, since communications, navigation and landing equipment can be combined in one receiver ;

— Large number of channels available in high frequency range ;

— Outstanding suitability of this frequency range for the tasks in question thanks to its physical properties, in particular the relatively sharply limited range of the installations corresponding to optical visibility, which means that the same frequencies can be used again.

Alongside these changes in American air traffic control, radio procedures for the *polar coordinate navigation* system (Rho-Theta system) were also introduced. This is a system of navigation by direction (θ) and distance (ρ) in relation to a fixed point. One advantage is that the radio signals can be shown on the aircraft's automatic pilot to simplify navigation and reduce strain on the pilot.

Present-day omni-ranges also contain the R/T band. Thus weather and other important messages can be transmitted on the same frequency without interrupting their functioning as navigation beacons.

VOR omni-ranges [2] to give direction are already in wide use in the U.S. ; a number of subsidiary instruments, such as the course selector, etc., have been developed,[3] and Distance Measuring Equipment is being widely tested.

In Europe, where VHF R/T communications were widely introduced after the war, the first step has been taken towards the modernization of short-distance navigation with a number of American VOR sets in Britain, France and Italy. A network of eight VOR installations, the first to be made in Europe, is now being constructed in

[1] Ultra-short waves are those whose frequency is greater than 30 mc/s, i.e., with a wavelength of under 10 m. They are divided into the VHF band (metre waves), UHF (decimetre waves) and SHF (centimetre waves).

[2] VOR (VHF Omni Ranges) work in the VHF band, on frequencies of 112 to 117.9 mc/s.

[3] T. v. Hauteville "En Route Navigation Systems and Air Traffic Control", INTERAVIA, Review of World Aviation, Vol. VI, No. 3, 1951, pp. 161-166.

Fig. 1 : External view of the first West German VOR omni-range. The beacon was constructed near Suttgart-Echterdingen airport by C. Lorenz AG. and was put into service on September 14th, 1951. It has a new type "cage aerial" (with rotating dipole).

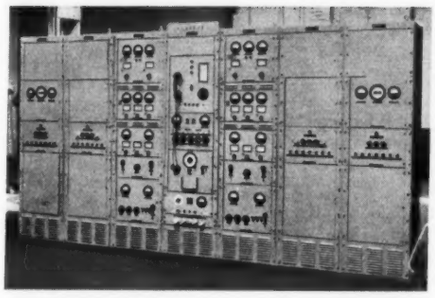


Fig. 2 : To ensure uninterrupted operation the equipment has double generators (end cabinets) and current supply (end but one cabinets), and double transmitter modulators (inside). The middle cabinet contains remote control, checking equipment and R/T amplifier.

Western Germany and is to be completed during the coming winter. The first of these installations *(fig. 1)* was set up near Stuttgart-Echterdingen and put into experimental operation in mid-September.

In these omni-directional beacons—developed and produced by C. Lorenz AG., Stuttgart and Berlin, according to the principles laid down by the International Civil Aviation Organization—the transmitter and its power supply, remote controls, etc., and the reserve equipment provided for safety reasons, are all grouped in one installation *(fig. 2)*. Only parts and valves obtainable in Europe are used. The equipment works with a new type of " cage aerial " with rotating dipole developed during recent years by the Federal laboratories of the International Telephone and Telegraph Corporation, New York. The cage serves as a kind of transformer for the short dipole, to adapt it to free space, and at the same time as polarization filter. It also contains the omni-directional aerial, in the form of a slotted circular plate. Advantages of the new aerial are greater simplicity—no transmission goniometer to produce the 30 c/s side-band frequencies—and the elimination of the internal errors of the aerials hitherto used (5 frames).

Functioning

The VOR ground station is a rapidly rotating omni-directional beacon which works on the *phase measuring method*. Direction is obtained on board the aircraft by measuring the difference in phase between the standard alternating field *(" reference phase ")* and the direction-controlled field produced by a rotating dipole *(" variable phase ")*. *Fig. 3* illustrates this principle in diagrammatic form.

Reference frequency B (30 mc/s) is modulated on to the transmission frequency by means of an auxiliary carrier and broadcast. It thus has the same phase at the same time in all directions. On the other hand the field produced by the rotating dipole (30 r.p.m.), which also creates a 30 mc/s alternating current V in the aircraft receiver, has different phases at the same time in different directions. The dipole's double diagram is transformed by the carrier auxiliary of the omni-directional transmitter into a *cardioid* which produces a full alternating current period in the receiver for every 360° rotation.

Thus the measurement of the phase difference between the alternating current produced by the cardioid in the aircraft receiver (" variable phase ") and the alternating current of the " reference phase " received separately through filters accurately gives the *azimuth* (angle between position of aircraft, ground station and North).

As it is important to prevent the reference alternating current from mixing prematurely with the variable alternating current produced by the dipole—the frequency is 30 mc/s in both cases—the reference current frequency modulates a 10 c/s auxiliary carrier,[4] with which the omni-directional high frequency carrier is amplitude modulated. In the receiver the 30 mc/s alternating current obtained through amplitude demodulation of the variable alternating field and through the frequency demodulation of the reference field is divided into two and fed to a direct reading phase measurer (fig. 4). With the aid of a phase shifter a zero instrument can be used for readings. Details of the various types of receiver can be found in the article on omni-directional range navigation by Richard Watson Thwing.[5]

Structure of the transmitter equipment

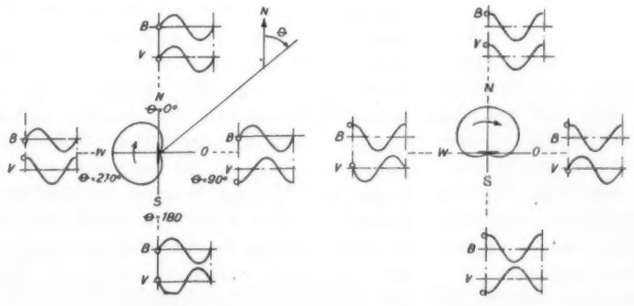
Let us now glance inside the equipment shown in fig. 2. *Fig. 5* shows a rear view of the right-hand part (cabinets 4 to 7). As the main equipment for the 60 c/s generator (cabinet 1), current supply (cabinet 2) and transmitter (cabinet 3) are arranged symmetrically to the reserve apparatus, this picture corresponds to the diagram of the VOR equipment given in *fig. 6*.

The high frequency produced in the quartz control stage of transmitter D is amplified in final stage E, modulated (modulator H) with the " reference phase " (auxiliary carrier), speech (R/T amplifier J) and call sign (stage G) and then passed to the non-directional aerial N.

A small percentage of the end stage power (roughly 15 %), whose high frequency carrier is again freed of modulation in modulation minimizer F, feeds rotating dipole O. The 10 kc/s auxiliary carrier, frequency-modulated at 30 c/s, is produced by a modulator wheel R which rotates with the dipole. A quartz-controlled single generator B (for 60 c/s) ensures regular rotation of synchronizing motor P (dipole and modulator wheel drive).

The beacon's emissions are received by a simple detector receiver T and passed to a control stage K. The latter checks the

Fig. 3 : Principle of the VOR phase beacon : The difference in phase, measured in the aircraft, between the omni-directional " reference phase " (B) and the " variable phase " (V) produced by the cardioid gives the azimuth (Θ) of the aircraft's position in relation to the ground station. For an azimuth of 90° (aircraft east of ground station) for example, the phase difference is always 90° : In the left-hand picture the reference current (everywhere) passes through zero, whilst the variable current produced by the cardioid (in the east) is at its minimum. When the dipole has turned through 90° (right-hand picture) the variable current (in the east) reaches zero; meanwhile, however, the reference current (everywhere) has increased to its maximum value.



VHF receiver

1 aerial
2 high frequency amplifier
3 mixer stage
4 oscillator
5 intermediate frequency amplifier
6 rectifier
7 low frequency amplifier
8 to headphones
9 to VOR equipment

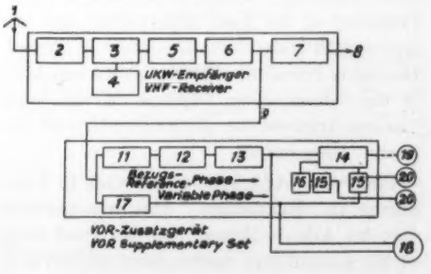
VOR equipment

11 10 kc/s filter
12 limiter
13 frequency modulation detector
14 phase regulator (remote controlled)
15 phase detectors
16 90° phase shifter
17 30 c/s filter
18 phase measurer (azimuth reading)
19 omni-bearing selector
20 instruments for zero and azimuth reading

[4] DRP 736979 of 30.8.1940, C. Lorenz AG., Stuttgart & Berlin.

[5] Cf. INTERAVIA, Review of World Aviation, Vol. VI, No. 4, 1951, pp. 213-217.

Fig. 4 : Diagram of a VHF R/T aircraft receiver with VOR auxiliary equipment.



proper functioning of the VOR installation in several different ways and reports all errors or failures in transmission via remote control instrument *L* to the control tower official at *M*. From *M* the reserve equipment can be switched on or instructions sent to the transmitter via a double cable (through remote control instrument *L*).

Fig. 5 : Rear view of the cabinet (for details see diagram, Fig. 6).

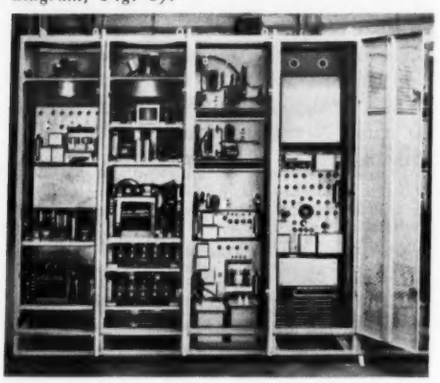
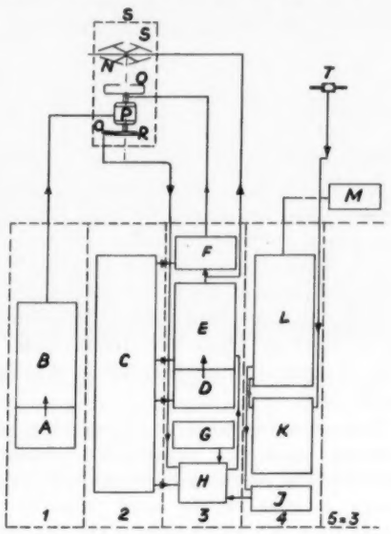


Fig. 6 : Diagram of Lorenz VOR beacon.



A — power supply
B — frequency-stabilized 60 c/s generator
C — power supply
D — control stage and amplifier
E — final stage
F — modulation minimizer
G — callsign transmitter
H — modulator
J — R/T amplifier
K — checking equipment
L — remote control equipment
M — control post
N — omni-directional aerial
O — rotating dipole
P — motor (1800 r.p.m.)
R — modulator wheel
S — cage
T — field detector

The simplicity of the VOR receiver equipment in the aircraft and the low susceptibility of the VHF band to atmospheric disturbances combine to ensure highly reliable operation. Thus the first essential for a navigation aid, that it should be reliable even under the poorest weather conditions, is fulfilled.

Aeronautical Equipment at the Turin Exhibition

– SEPTEMBER 22nd TO OCTOBER 7th, 1951 –

By Giorgio Lourier, Rome

Although not strictly an aircraft exhibition, the Turin "*Salone della Tecnica*" nevertheless had much to offer of interest to the aircraft industry. There were participants from seventeen different countries, whose 1152 stands gave impressive evidence of advances in production methods and provided an excellent sample show of new metallurgical materials and plastics.

Another point is that two of the Exhibition's chief organizers—Count Giancarlo Camerana and Daniele Derossi—are among the leading personalities in the Italian aircraft industry. Count Camerana is Vice-President of the Fiat undertaking and has represented Italy's aviation interests abroad. Derossi is President of Microtecnica and head of the "Equipment" section of the Associazione Imprese Aeronautiche (Aircraft Industry Association).

Finally the AIA held a conference in Turin during the Exhibition. This was presided over by Alfredo Bruno, and discussed some of the present-day rearmament problems of the Atlantic Pact countries. Needless to say, the conference also paid a number of visits to the Exhibition.

For all these reasons therefore the Turin Technics Exhibition should not be passed over in silence.

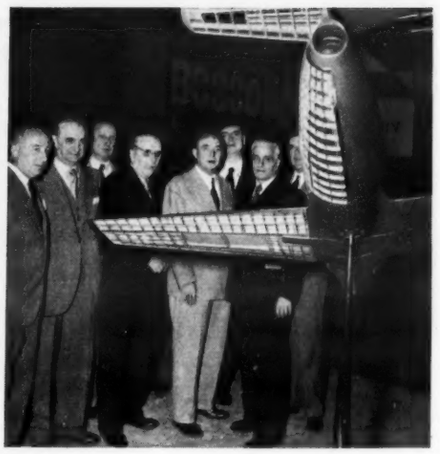
Metallurgy and Machinery

The metallurgy section included a series of high-grade steels of new composition, shown by the Italian firms of *Compensa Acciai*, *Dalmine* and *Falck*.

Machine tools of all sorts and sizes formed more or less the nucleus of the Show, and it was learned that the Machine Tool Industry Association *(UCIMA)* had just received orders to a value of 14,000,000,000 lire from American and British industry, to be completed by the end of 1952. In addition there were industrial and scientific measuring and checking instruments, calculating machines and other precision apparatus.

The grinding machines shown by *Olivetti* (Ivrea) aroused considerable interest, as did also the machine tools and checking instruments of the *Officine Meccaniche Aeronautiche* (Mario Cabiati) and the automatic control and measuring instruments of the *Compagnia Elettronica* (Rome). *Microtecnica* showed ciné-cameras, but their navigation instruments (in particular gyro compasses) and automatic pilots were to be seen only in the form of photographs.

The *Fiat Works*, the biggest industrial concern in Turin, or even in Piedmont were represented by models of their Sangone gas turbine test bench and two-seater G.80 jet trainer (both seen already at the Paris Air Show). There were also demonstrations of electronic instruments for checking piston engines, measuring benches for crankshafts, oscilloscopes for various purposes, stroboscopes for checking injection nozzles, etc. During the Show it was announced that the Aeritalia aircraft works had produced a new two-seater trainer, to crown the long list of successful Fiat trainers.



View of the large exhibition building at Valentino, Turin, during the 1951 "Technics Exhibition"; and the Committee of the Italian Aircrat Industry Association (AIA) on the Fiat stand (right to left: Dr. P. Foresio, President of Aeronautica Macchi; A. Bruno, President of AIA; Marchese Rodino, President of IMM; Prof. G. Gabrielli, Technical Director, FIAT; A. Ambrosini, President of SAI; Zerbi, of Breda, Rome; Count Perotti, of Fiat, Rome; Berretta, of Fiat, Turin).

The Fiat G.49

There is no need to remind our readers of the numerous Fiat trainers in which thousands of civilian and military pilots from the Danube countries, South America and Italy herself, were trained before and during World War II. Continuing this long tradition, Fiat went on developing trainers after the war, and brought out the G.46, G.55 and G.59, which are today in use in Italy, Argentina and Egypt. With their latest design, the G.49, the Turin works have now brought out a trainer for the second stage of training of military pilots.

The G.49 is a low-wing monoplane with a span of 42 ft. 7¾ in. and a wing area of 262.42 sq.ft. (aspect ratio 6.95). It has a retractable tail wheel undercarriage and seats in tandem. It is to be built in two versions, the G.49-1 (with 570 h.p. Alvis "Leonides") and the G.49-2 (with 600 h.p. Pratt & Whitney R.1340).

Details of G.49-1: Weight empty 4,300 lbs; load 1,190 lbs; gross weight 5,490 lbs; wing loading 21 lbs/sq.ft.; power loading 9.7 lbs/h.p.; max. speed at 3,280 ft. 234 m.p.h.; min. speed (with flaps) 68 m.p.h.; service ceiling 26,570 ft.; range 620 miles (3½ hrs. at 177 m.p.h. at 13,120 ft.) or 1040 miles (with larger fuel supply).

Olivetti's R4-300 grinding machine has eight working speeds.

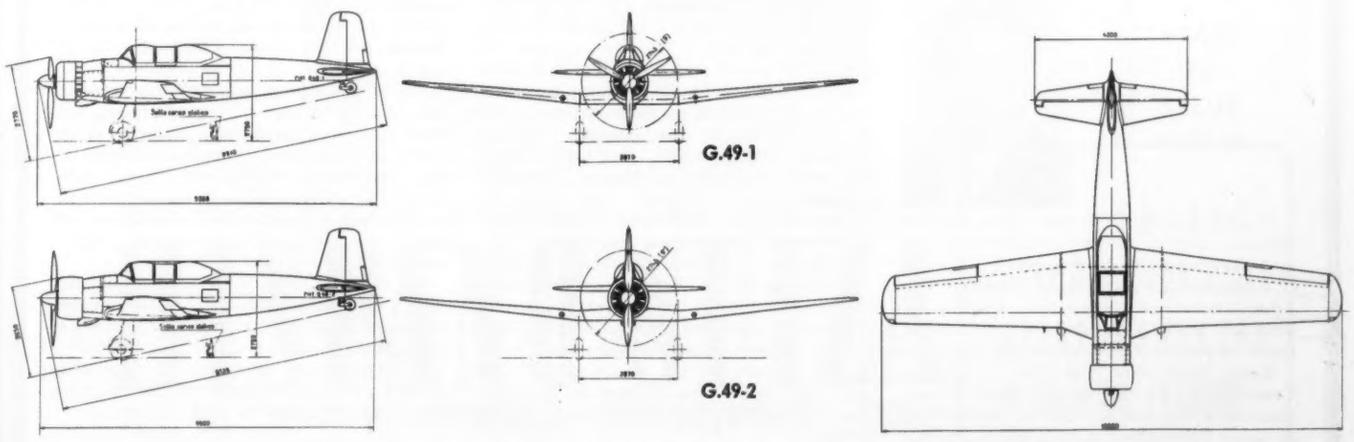
Details of G.49-2: Weight empty 4,310 lbs.; pay load 1390 lbs.; gross weight 5,700 lbs.; wing loading 21.7 lbs/sq.ft.; power loading 9.5 lbs/h.p.; max. speed at 4,920 ft. 235 m.p.h.; min. speed (with flaps) 72 m.p.h.; service ceiling 25,430 ft.; range 680 miles (3½ hrs. and 195 m.p.h. at 13,120 ft.) or 1,090 miles (with supplementary fuel tanks).

Electrical and electronic engineering

Magneti Marelli (Milan) showed four new radio instruments of interest to aviation:

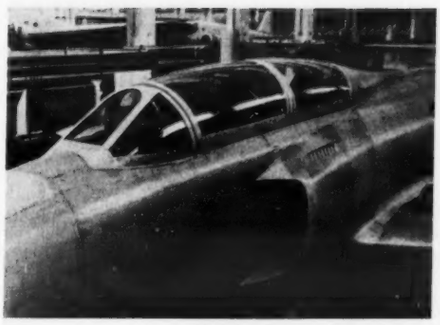
— A fixed relay station (impulse modulation) for the multiple transmission of hertzian waves in ground communications, similar to the stations already in use on the Rome-Milan military communications route.

— A VHF transmitter-receiver, suitable, for example, for air traffic control at fixed stations.



Three-view drawings of the FIAT G.49-1 (Alvis "Leonides 502") and G.49-2 (Pratt & Whitney R-1340) trainer.

"Vitros" glass wool produced by the firm of Vetrocoke, used for sound insulation in the Fiat G.212 three-engined civil transport.



The plexiglas cover (Vetrocoke) in the new jet-powered Fiat G.80 trainer.

— A remote-controlled VHF ground station (transmitter-receiver) for two-way communications between control tower and pilot during approach and landing.

— An efficient HF receiver for professional use.

Alfa Romeo (Milan), who are primarily producers of automobiles and aircraft engines, had a generator group with fully automatic control, which can be used, among other purposes, to supply emergency current for airports and air traffic control centres.

The Turin shops of *P. Aita* showed alternating current signal equipment, which works without moving contacts and thus does not produce sparks to interfere with radio instruments.

Earth-moving machinery.

In conjunction with the Exhibition a *Centro nazionale meccanico agricolo* was organized at the unused airfield of Mirafiori, to show earth-handling machinery such as is used for building (and maintaining) airfields. Machines included bulldozers, dredgers, levelling machines, tractors, etc. Principal exhibitors were *Fiat* and *Breda*. The firm of *F. & C. Fiorentini* (Rome), which exports in quantity to the Soviet Union and other Eastern countries, showed road-building machinery and dredgers for harbour construction.

Plastics

Plastics of interest in aircraft construction included above all the translucent thermal plastics (for cabin roofs, windows, etc.) and compressed or laminated plastics (for mechanically stressed parts). There were also vinyl combinations and poly-ethylene, used for electrical circuits.—New uses for plastics included the replacement of light metals by compressed plastics (e.g. for window frames), sound insulation of the cabin walls of airliners and finally a series of "plastic textiles" for seat coverings, etc. Examples of suitable materials for all these purposes were on show at Turin.

The large number of exhibitors surprised even the experts. They included Officine di Villar Perosa (Plastics Division, Turin), Monsanto Chemicals Co. (St. Louis, Missouri, London and Montreal), Industria Chimica CIBA (Milan), Montecatini, An. Gomma Ebanite Similari, Officine Bandera, P. Carini, Cigala & Bertinetti, Co. Ma. Pla, Anthony Cole, Flexa, Importazioni Materie Prime Industriali, Lavorazioni Rosini Sintetiche, Leghe Porose, Th. Mohvinkel, Orloff, Soc. Industriale Dermoide Affini, Luigi Taglioni (Plexiglas). Mention should also be made of the firms of *Industria Materiali Termoplastici* and *Vetrocoke*. The former exhibited the transparent cabin roof of the "Rondone F.4" (in quantity production at SAI-Ambrosini), and the latter plexiglas parts and sound-proof insulating material (based on glass wool).

Finally there was such auxiliary equipment as *Bergomi's* fire extinguishers (used at Italian airports), *Emanuel's* compressors and hoists, etc., *Pirelli's* rubber parts, and the "Populit" parts of the *Soc. An. Fabriche Fiammiferi Affini.*

*

This long list of names (which could be extended almost indefinitely) is a good indication of the efforts at reconstruction and expansion being made by Italian industry. The "Technics Exhibition" is an annual event, and it can be forecast that next year's Exhibition will have even more interesting things to show in the aviation world. Turin is after all the most important aviation centre in Italy and one of the most important in Europe.

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DEATH OF EUSTE NARDI

On October 7th, 1951, the Italian aviation industry lost a talented engineer and a first-class organizer in the person of Doctor of Engineering Euste Nardi, President and Administrator of the aircraft construction company of the same name, who died as the result of a short illness at the age of 49.

Euste Nardi, who was born in 1902 at Venarotta in the province of Ascoli-Piceno, obtained a diploma in industrial engineering at Milan Polytechnic in 1926 and a diploma in aeronautical engineering at the School of Aeronautical Engineering, Rome, in 1927, where he was assistant to Professor Ancona and, later, lecturer. The following year he joined the board of management of Società Italiana Ernesto Breda at Sesto San Giovanni, and obtained his pilot's licence at the school then run by the Company. He left Breda in 1933 to found, with his brothers, the Nardi Aircraft Construction Company in Milan.

The Company developed rapidly under the shrewd, enlightened guidance of its management. The first success was obtained with the Nardi F.N. 305 aircraft, first flown in February 1935 by the Italian ace, Arturo Ferrarin. This first Nardi aircraft gained several international records for Italy. Thanks to its excellent qualities, over 600 were built and it was adopted by six countries besides Italy for the training of fighter pilots.

The Nardi works in Milan employed a considerable staff, and in 1939 a second factory was acquired near Loreto aerodrome, Marches, where a process of industrialization was in progress.

Besides designing and building trainers and touring aircraft of various types, the Nardi Company undertook, under the leadership of Euste Nardi, a number of original and interesting studies concerned with aviation accessories, in particular retractable undercarriages, armament, fuel and oil pumps, etc., thus making a notable contribution to aeronautical progress.

The death of Euste Nardi occurred on the eve of the appearance of a new aircraft which the Nardi Company is now producing at its Milan plant.

The Company's work will be continued, in memory of its founder, by his brothers and their collaborators.

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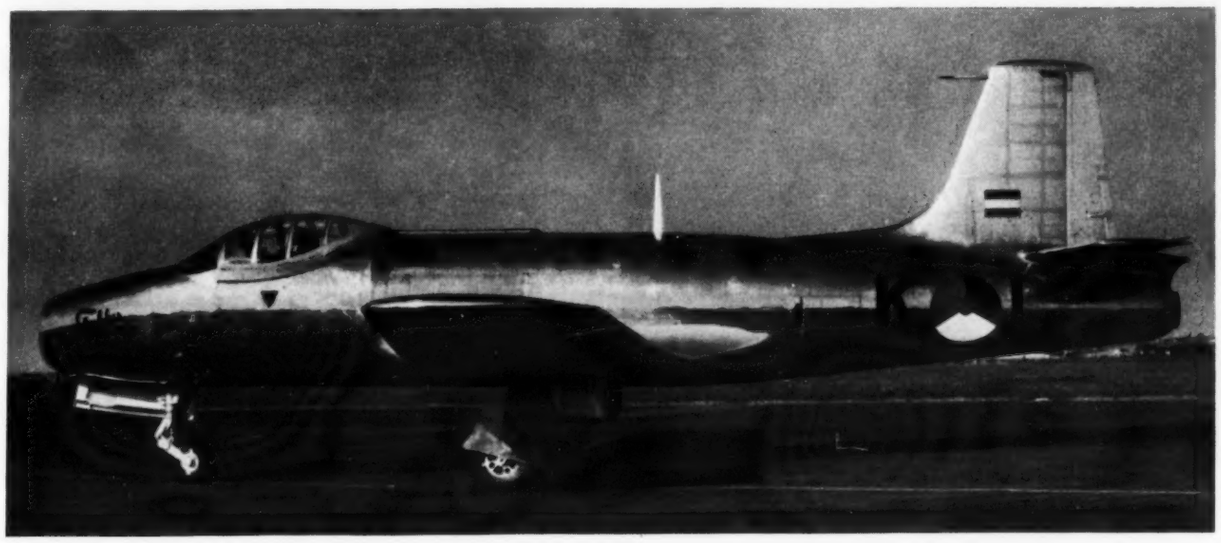

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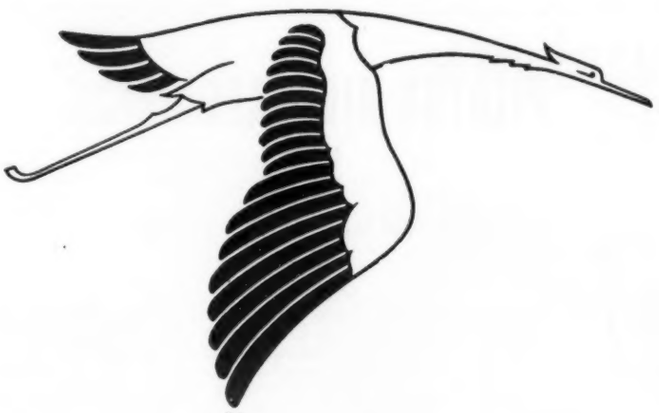

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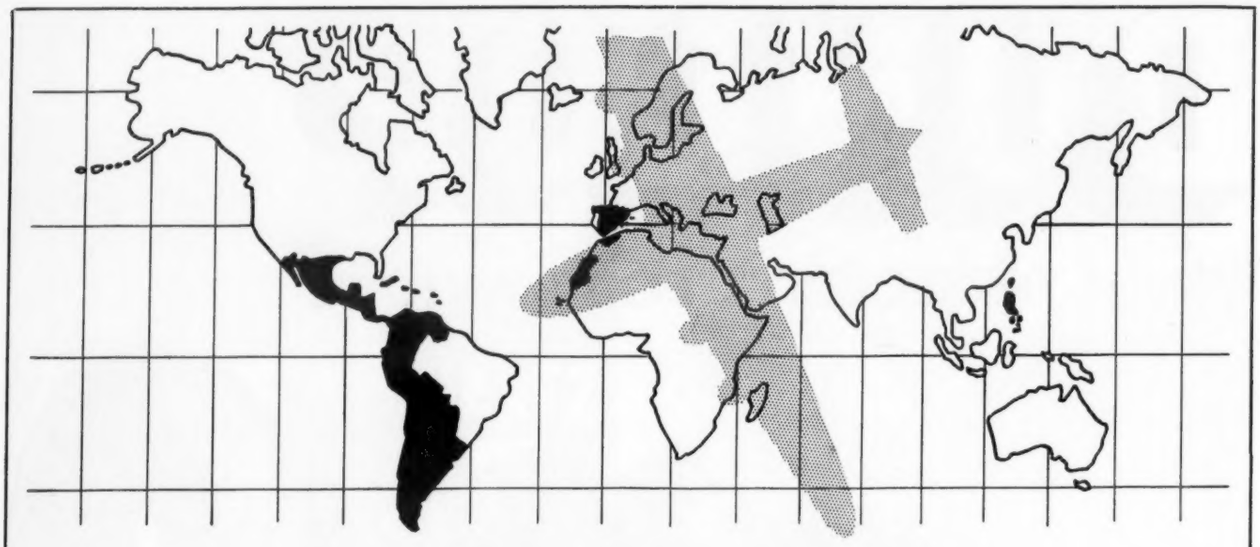

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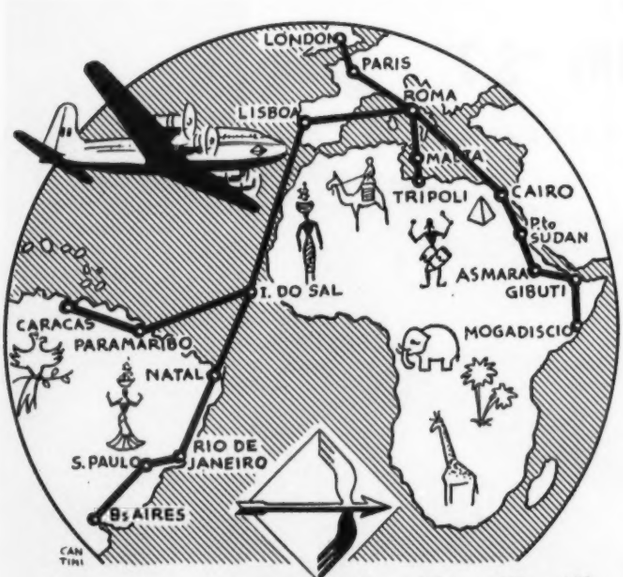

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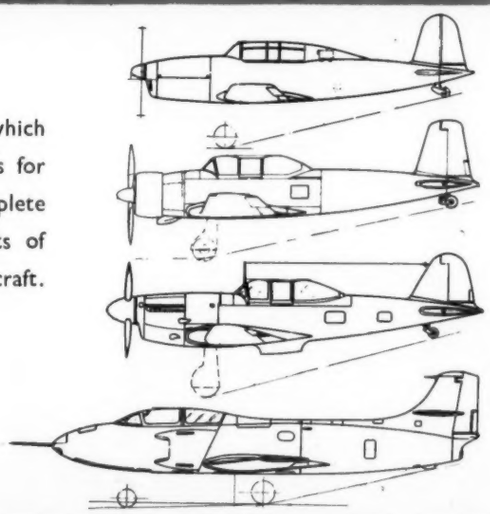

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